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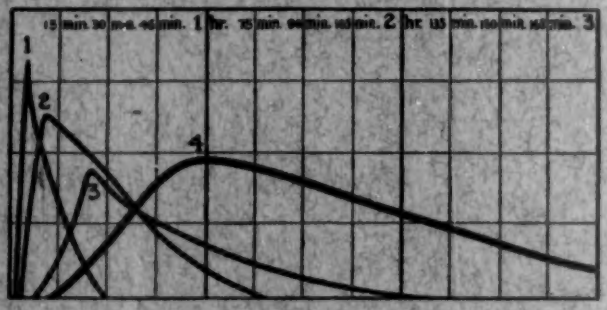

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ANNALS *of* SURGERY

Vol. XCI MAY, 1930 No. 5

EFFECT OF HIGH PROTEIN DIET ON THE VELOCITY OF GROWTH OF FIBROBLASTS IN THE HEALING WOUND*

By Samuel Clark Harvey, M.D. and Edward Lee Howes, M.D.

of New Haven, Conn.

from the department of surgery, yale university

The first step in the healing of an uninfected wound in which the tissues are maintained in close approximation is the restoration of their continuity by the proliferation and maturation of connective tissue. In most instances in the more highly organized and parenchymatous organs or tissues there

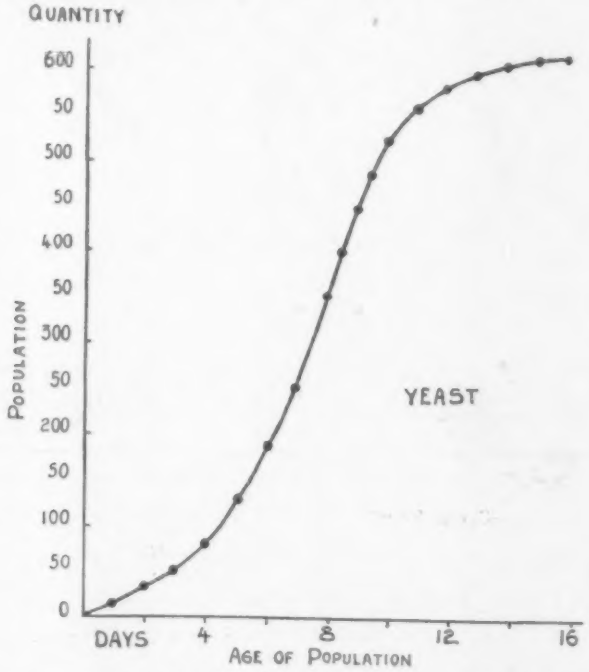

Fig. 1.—Growth curve of yeast population; after Brody and Pearl.

is no restoration of the specific function of these but the end-result is a scar. Where the function is purely mechanical, however, there is necessarily a functional as well as an anatomical result. It is very important to understand as clearly as possible the mechanism by which such a healing is accomplished and the factors which may affect the process.

While the clearing away of the débris of the damaged tissue and the

* Read before the American Surgical Association, May 3, 1929.

vascularization of the process are essential, the master reaction is that of the multiplication and growth of the fibroblasts which are to form the cicatrix. A function of this is the change in the tensile strength of the healing wound which can scarcely be dependent upon else than the increase in the number of the fibroblasts and the degree of condensation of the connective tissue. When plotted as a velocity curve, this has certain characteristics which are analogous to similar graphs of growth of populations, of metazoa, and of the changes in a monomolecular chemical reaction.[1] (Fig. 1.) This curve of the healing wound was first demonstrated by determining its strength in skin, muscle, fascia and the stomach wall of the dog.[2] (Fig. 2.) Later, with more simple and better controlled observations a similar curve was plotted

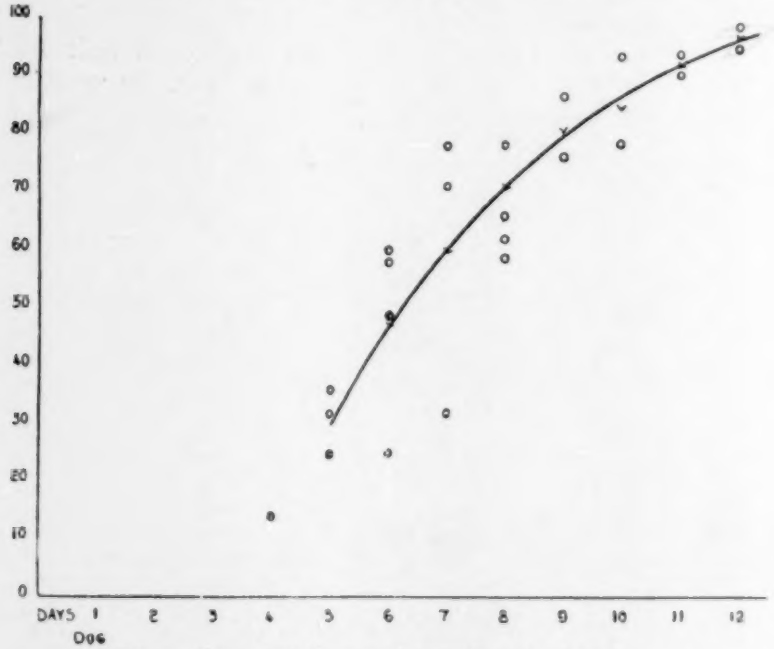

FIG. 2.—Curve of tensile strength in healing wounds of dog.

from experiments upon the stomach of the rat.[1] (Fig. 3.) It is the purpose of this paper to discuss further observations upon the velocity of fibroplasia in the healing wound of the stomach of the rat, particularly in relation to variations in the diet.

The albino rat was chosen as the experimental animal in part because the relatively low cost, as compared with that of the dog, permitted the multiplication of the experiments; in part because this animal has been so thoroughly studied as regards its growth under standardized diets, both adequate and deficient. It is also possible to obtain rats that have been bred from pedigreed stock and fed throughout life on a correct maintenance diet. The size of the tissues rendered it necessary to devise a particular technic for the determination of the strength of the healing wound. The experiments

upon the dog had indicated that wounds in the wall of the stomach healed with uniformity, consequently this organ was chosen in the rat. It being impossible because of the size to determine the tensile strength directly, it was decided to estimate this in terms of the breaking point of the wound when the stomach was distended with air. The animal was killed with ether, the œsophagus tied and the stomach removed, it being kept moist with physiologic

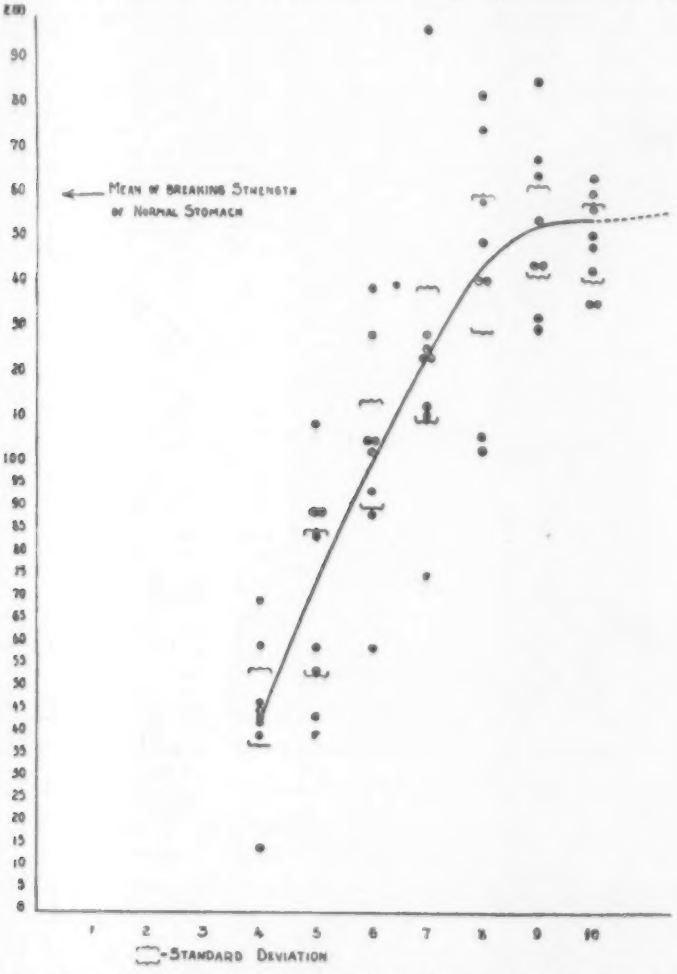

Fig. 3.—Curve of velocity of growth of fibroblasts in healing wound of the stomach of the rat.

saline during all manipulations. A cannula was inserted through the pylorus and this connected to a pressure line to which was attached a mercury manometer carrying a writing point against a revolving drum. Air was admitted at a constant and uniform rate in all experiments, as checked by the rapidity of rise of the mercury. Calibration of the graph against the manometer enabled one to read off the pressure at the time of rupture of the stomach or wound in terms of the height of the column of mercury. (Fig. 4.) It is conceded at once that this gives no absolute value of the strength

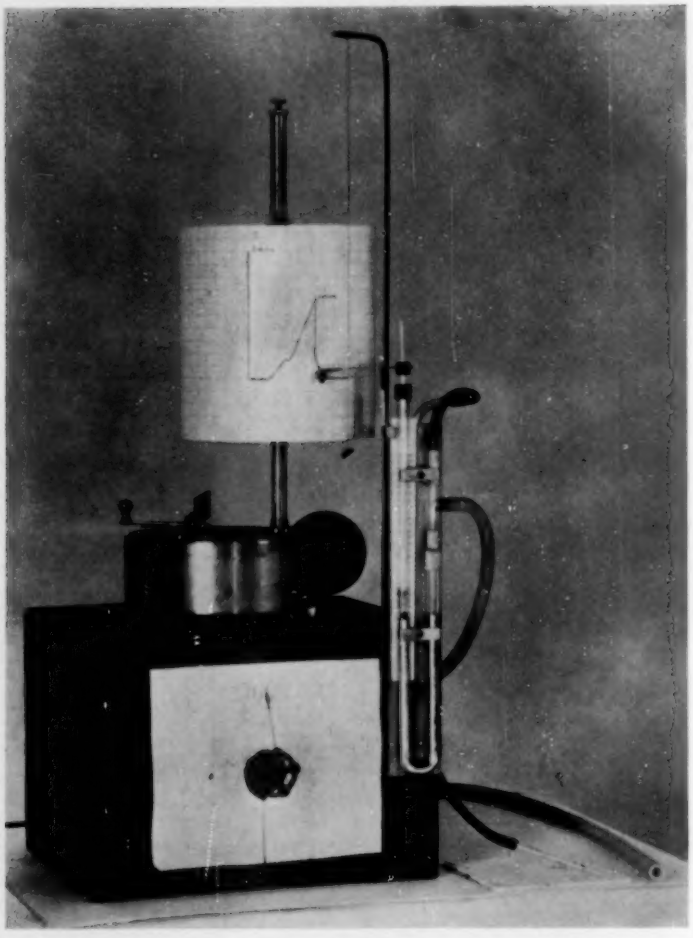

FIG. 4.—Apparatus for testing tensile strength of rat's stomach.

of the stomach or of the wound but inasmuch as the data desired are that of the relative change in strength, the method seems adequate.

In order to determine possible variations in relation to sex, weight or age, the breaking strengths of many stomachs of rats showing wide variations in these factors were determined. These animals were obtained from various sources and were homogeneous only in that they had not been subjected to operative procedures upon the stomach.

The following data were obtained:

Sex	Observations	Mean hg.	Mean deviation
♂	29	146	19±
♀	24	142	14±
Age (days)			
36–100	21	138	13±
100–200	12	145	28±
200–300	1	154	0±
300–400	9	146	15±
400–541	19	154	17±

Sex	Observations	Mean hg.	Mean deviation
Weight (gms.)			
35–100	20	135	13±
100–200	13	145	23±
200–300	16	146	18±
300–400	3	164	1±
400–485	9	160	18±
All cases, 35–485 gms.	61	148	17±

An analysis of these data shows no marked trend as regards sex, weight or age. It was decided to use adult rats of the weight between two hundred and four hundred grams and at least ten months old for the initial experiments upon the velocity of the curve of healing. These rats were obtained from two sources; from the Osborn and Mendel strain and from the Albino Supply Company. They had always been on a standard maintenance diet and had had normal growth. Under ether anæsthesia a wound approximately one centimetre in length was made through the wall of the stomach on the anterior surface transversely to the long axis and at the junction of the middle and distal thirds. This was carefully approximated in two layers with No. 000 plain catgut which from previous experiments is known to disappear within three days.[3] The method of suture was always the same. The animals were maintained on a Sherman Diet:

⅔ whole wheat
⅓ whole milk powder
1 per cent. weight of wheat as $CaCO_4$
1 per cent. weight of wheat as NaCl
Lettuce twice a week
70 milligrams of yeast daily.

The velocity curve previously reported[1] was obtained in this fashion. While showing that the major part of the curve corresponded with the "growth retarded" phase, the lag period was not sufficiently explicit, nor were the data sufficient to interpret the findings after the ten-day period.

EXPERIMENTATION

In order to obtain further information on these sections of the curve and in addition to cover the effects of a high protein diet upon the rate of wound healing the following experiments were performed.

The diets employed by Smith and Moise[4] were used and the rats were placed on these one week before the operative procedure.

DIETS (Smith and Moise)

Percentage Composition	Calories per Kilo of Food	Apportionment of Total Calories
Standard Balanced Diet		
Per cent.		Per cent.
Casein 18	738	Protein 13.8
Starch 51	2,091	Carbohydrate 39.2
Crisco 22	2,046	Fat 47.0
Cod-liver oil 5	465	
Salts (Mendel and Osborn mixture) 4	5,340	
Lettuce twice a week		
70 milligrams of yeast daily		

	Per cent.	*High Protein Diet*		Per cent.
Casein	80	3,280	Protein	68.7
Crisco	12	1,488	Fat	31.8
Cod-liver oil	4			
Salts	4	4,768		

Lettuce twice a week
70 milligrams of yeast daily for Vitamin B.

The animals and their food intake were weighed every three days. They were fasted for six hours pre-operatively but were put back on food immediately after the operation and many of them started to eat as soon as they had recovered from the anæsthetic. Six animals were sacrificed at daily intervals from one to the fourteenth day and their

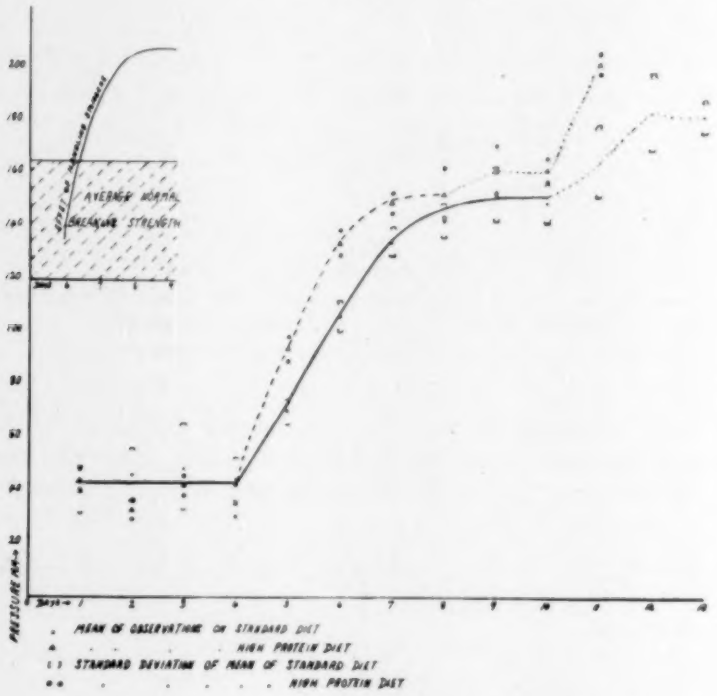

FIG. 5.—Effect of diet on the healing of stomach wounds of rats.

stomachs inflated and the breaking point determined as previously described. If disease elsewhere or infection of the wound was found, the animal was discarded.

Results.—The curve for the standard diet was similar to that obtained previously with the Sherman Diet. (Fig. 3.) The high protein diet as contrasted with the standard diet had no effect on the latent period of wound healing, but it did enhance the rate of increase of tensile strength throughout the period from the fifth to the ninth day. (Fig. 5.) (Table I.) The high protein diet also shortened the end point of the curve from the thirteenth to the eleventh day.

(The end point has been arbitrarily set at that period when all the breaks were elsewhere than at the site of the incision. For three or four days before this end point was reached there was a period in which three distinct types of rupture were noted; alongside the incision, directly in the incision, and elsewhere in the stomach than in the incision. [Table I.] As this period approached the arbitrary end point, the number of

TABLE I

P. O. days	Standard diet			Protein diet		
	Mean of tensile strength	Standard deviation of mean	Nature of break	Mean of tensile strength	Standard deviation of mean	Nature of break
1	41.5	± 9.0		45.4	±4	
2	47.5	± 9.0		33.6	±4	
3	49.9	±15		42	±3	
4	45.8	± 8		38.6	±7	
5	71	± 5		94	±5.4	
6	107	± 6		135	±5	
7	135	± 5.4		150	±5.3	
8	143	± 6.8		154	±9	2 elsewhere, 1 alongside, 4 incision
9	153.5	±10		162	±8	1 elsewhere, 2 alongside, 3 incision
10	150.5	± 7	1 alongside	162	±4	2 elsewhere, 3 alongside, 0 incision
11	166	±13	2 alongside, 3 incision, 4 elsewhere	202	±4.4	5 elsewhere, 1 alongside, 0 incision
12	185	±15	4 alongside, 4 elsewhere			
13	183.9	± 7	None in incision, 7 elsewhere			
14	206	±10	All elsewhere			

breaks in the incision decreased while the number of breaks in the stomach itself increased. Both curves are smooth until the beginning of this period, as only one function, the strength of the wound itself, is being tested, but during this period the curve is staggering because two functions, the strength of the wound and the strength of the stomach are being tested.)

It might be presumed that the enhancing effect of the high protein diet was due to an increase of caloric intake on this diet. However, the caloric intake on the protein diet was actually lower than that on the standard diet. (Fig. 6.) On both the animals consumed a smaller number of calories daily on the first two post-operative days than they did on any pre-operative day. This post-operative decrease in caloric intake was reflected in a loss of body weight during this period. They had maintained their weight on both diets pre-operatively. (Table II.)

TABLE II

Average Maintenance of Body Weight per Day

(Calculated as percentage of body weight at the start of the experiment)

	Start to Operation	Operation to Killing
Standard Diet	+ .3 per cent	− .5 per cent
Protein Diet	0	− .5 per cent

Discussion.—For purposes of discussion the curve may be divided into three portions, the lag period, the period of fibroplasia where the velocity is changing most rapidly and the final phase of the approaching maximum immediate strength.

In all phenomena of growth there is a lag period, which at first thought seems most readily interpreted on the basis that the increment of the measur-

able factor is not sufficiently great to be detected. Such is not the case, however, for with the transplantation of one microörganism into a fresh environment, there is a pause before it begins to divide, as if it were necessary for some stimulating substance produced by itself to reach a certain saturation in order to effect this change. With each succeeding division the interval decreases and the curve sweeps upward in the first phase of an autocatalytic reaction. (Fig. 7.) If, on the other hand, the implantation is large, the lag period is much less, and the curve apparently starts at a higher point, so that the accelerating phase is short and even entirely absent, the greater part or all being in the "growth retarded" phase. This lag period during which the stimu-

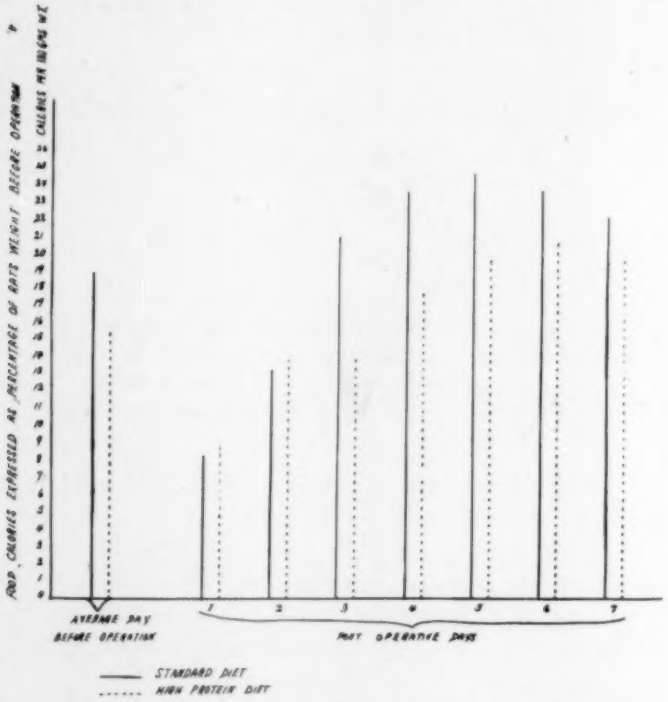

FIG. 6.—Effect of operation on post operative caloric intake of food.

lus to division is accumulating up to a certain point where it is sufficient to set division in action has been previously noted in wound healing. In the data of Durbin [5a] as studied by Thompson [5] upon the regeneration of the amputated tail of the tadpole, the new growth starts after a lag period with little if any phase of acceleration, the greater portion of the reconstruction being in the "growth retarded" portion of the curve. (Fig. 8.) Carrel [6] and his collaborators noted the same phenomenon in the healing of surface wounds, the lag being from three to five days and followed by the abrupt initiation of growth at its greatest velocity. In both instances it is apparent not only that when the stimulus to growth reaches a certain threshold value the many cells in the wound exposed to its action at once start dividing but that the rate immediately becomes retarded so that the healing takes place in the "growth retarded" phase of the growth curve. This occurs likewise in the experiments

upon the rat's stomach. There is perhaps a sufficient density of the population of fibroblasts at the start, so that they at once exert an increasingly retarding effect upon their rapidity of division. At least by the time the tensile strength is beginning to increase at about the fifth day, this is taking place. During the lag period the tensile strength is at the start maintained up to a pressure of twenty-five millimetres of mercury by the sutures which give the immediate strength of the wound, and in the course of a few hours by the deposit of fibrin between the two surfaces. This retains them in contact against a pressure up to forty-five millimetres of mercury until the fifth day when the tensile strength of the fibroplasia surpasses this level.

This lag period was remarkably constant in the experiments in the skin, fascia, muscle and stomach of the dog and also in the stomach of the rat. In the latter both with the normal maintenance and with the high protein diet, this was true. That it may be shortened has been suggested by Clark,[8] who, working with surface wounds according to Carrel's technic, observed a

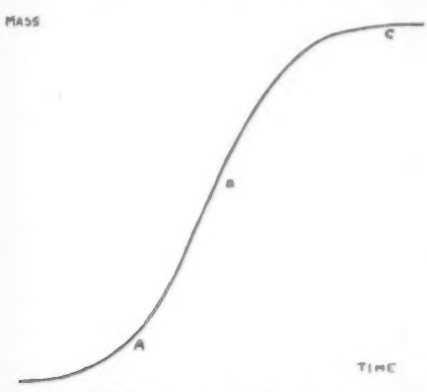

FIG. 7.—Curve of transformation in an autocatalyzed monomolecular reaction; after Robertson.

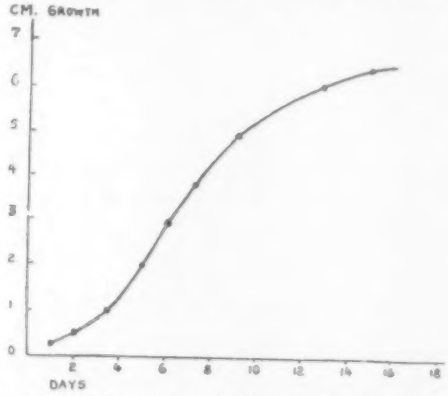

FIG. 8.—Curve of regenerative growth of tail in larger tadpoles; after Thompson.

decrease in the time of the initiation of the growth under a high protein diet. Carrel[7] has himself delayed the initiation of growth by the careful occlusion of the wound from "irritation." He has also initiated regeneration on the first day by applying such an "external irritant" as turpentine. The factor of external irritation is presumably minimal or at least constant in internal wounds.

Whether or not changes in the velocity of the fibroplasia can be brought about is of the greatest interest. Carrel[9] has studied the stimulatory action of embryonic tissue juice upon such cells grown *in vitro* and has determined that this is due to an increased concentration of proteose. Moise and Smith[10] have found that the hypertrophy of the remaining kidney after a unilateral nephrectomy in the rat is greater and more rapid on a high protein diet, Certainly our experiments on the stomach of the rat indicate that under a diet in which the protein content is relatively high, the velocity of growth of the fibroblast in the healing wound is distinctly increased.

In considering the terminal phase of the graph, it is seen that both curves pass into the zone where the stomach customarily breaks. It is evident also

that the stomach in these instances where an operative wound has been made has a greater breaking strength than those not operated upon. (Fig. 5.) One cannot escape the deduction that the manipulation of the stomach has produced some change within its walls which has led to an increase of strength. This can scarcely be otherwise than a reaction to injury which has not been solely confined to the wound area but generalized throughout the entire organ. Whether or not this is due to an increase in the connective tissue is not as yet determined and may not be determinable by the qualitative method of histologic study. Whatever may be the mechanism it enables one to follow the velocity curve through until the wound has attained a strength manifestly greater than that of the stomach before operation. The protein diet, while accelerating the rate of regeneration also brings the wound to a maximum at a period at least two days earlier than that of the rats upon a normal maintenance diet. This maximum remains the same in both instances. In other words the effect of the high protein intake within the limits of this experiment is that of accelerating the rate with which the wound heals but of not affecting its immediate maximal strength or of changing the initial lag period.

SUMMARY

1. The latent period preceding the initiation of growth in the healing wound in the stomach of the rat is not affected by a high protein diet.

2. Once growth has started the velocity of it is distinctly increased by a high protein diet.

3. As a result of this the maximum strength of the healing wound is reached some two days earlier than is the case on the standard diet.

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THE INCIDENCE OF ALLERGY AND ASTHMA IN A GROUP DEVELOPING POST-OPERATIVE ATELECTASIS

By Harry B. Wilmer, M.D. Herbert Marshall Cobe, M.D. and Walter Estell Lee, M.D.

of Philadelphia, Pa.

From the Wilmer Research Fund at the Germantown Hospital

In previous reports of our clinical and experimental studies of the post-operative complication of atelectasis we have stressed the finding of three constant etiological factors:

1. The embarrassment of respiratory movements resulting from posture, painful wounds or an abnormal increase in intra-abdominal pressure.

2. The inhibition or loss of the cough reflex, resulting from the pain consequent to the act or following the administration of such sedative drugs as morphia.[14]

3. The presence of a thick, viscid secretion in the bronchi.

We have suggested [1, 2, 3] that the combination of these factors results in the accumulation of thick, viscid bronchial secretions in the dependent portions of the bronchial tree which the patient is unwilling or unable to expel because of painful wounds, muscular weakness and the inhibition or loss of the cough reflex. When this stream of viscid secretion reaches such a bulk as to occlude the lumen of the bronchus at one or more points, atelectasis in varying degrees develops in the pulmonary tissues distal to the point of obstruction.

We have studied this phenomenon by means of the bronchoscope [1, 2, 3, 4] in twenty-four cases, and have been able to relieve the obstruction in all of them by bronchoscopic drainage. We have also reproduced a similar lesion in dogs [5] with the bronchial secretion removed from a patient with post-operative atelectasis. Further [5] we have produced massive atelectasis in dogs when a viscid mass prepared from acacia (Ravdin), having the same physical properties as the obstructing bronchial secretion found in post-operative atelectasis, was introduced into the main bronchus of the animal.

It is not our purpose in this clinical report to review the subject of post-operative atelectasis. From a study of the literature which has been made possible by the complete bibliography compiled by Bowen,[6] the consensus of opinion at the present time seems to agree with Gairdner's [7] original explanation, namely, that atelectasis is the result of the blocking or plugging of the main bronchus supplying the involved pulmonary tissue. Coryllos and his associates have contributed richly to the recent literature [8, 9, 10, 11, 12, 13] and are not only convinced that obstruction is the cause of post-operative atelectasis or so-called post-operative pneumonia, but that lobar pneumonia

is infectious lobar atelectasis, and bronchial pneumonia is infectious patchy atelectasis.

We have suspected for some time that we were observing the terminal stages of the phenomenon, and with others, Cutler, Scott,[15, 16, 17] and Churchill,[18] have not been entirely satisfied with the facts at hand. When our first case of post-operative atelectasis, so successfully treated by bronchoscopic drainage, required subsequent treatment for hay fever, we became interested in the statement of Wilmer, that atelectasis occurs very frequently in asthmatics, and the observation of Clark,[20] based on his review of case reports in literature (Scott [15, 16]-Lee [1, 2, 3, 4, 5]-Bowen [6]), that the incidence of asthma and allergy was very high in patients developing post-operative atelectasis. Finally, when in our last three cases of post-operative atelectasis, we obtained definite histories of allergy or asthma, a review was started in a group of cases that we have been able to follow up.

As a result of this study we wish to report the following:

1. Ten cases of post-operative massive atelectasis have been followed and an analysis of their histories and careful testing has shown all ten of them to be definitely allergic.

2. In all cases the consistency of the sputum has been described as viscid, tenacious and purulent, and apparently similar in its physical properties to the bronchial secretion so characteristic in all allergic individuals manifesting respiratory symptoms.

3. In the positive cutaneous tests we found five reacting to pollen; two to animal emanation; two to bacteria; and one case with eczema probably had a food sensitivity. In listing the results of the tests the major reactor was the only one recorded, but most of the cases reacted to more than one protein.

Conclusions.—The surprising incidence of asthma and allergy found in this small group of patients who developed post-operative atelectasis, suggests another etiological factor that should be considered in the study of this phenomenon.

Case I.—W. G., age forty-two years, Polish, married. Admitted to the Bryn Mawr Hospital October, 1929. Direct inguinal hernia containing a diverticulum of the bladder.

Operation December 8, 1929.—Under gas-oxygen-ether anæsthesia a radical repair of the hernia was done by Doctor Lee. Immediately following the operation the man seemed to have more bronchial secretion than usual and with this there was a certain amount of dyspnœa and respiratory distress. He could not or would not cough and at the end of forty-eight hours his temperature had reached 101° F., respirations were 40, and there were signs of consolidation in the right chest posteriorly. Röntgen-ray examination showed massive atelectasis of the middle and lower lobes of the right lung.

Bronchoscopic examination and drainage by Dr. Gabriel Tucker. His report is as follows: The mucosa of the larynx and trachea was slightly inflammed. A considerable quantity of thick, yellowish, purulent secretion was found in the tracheo-bronchial tree, coming entirely from the right lung. The right lung was explored and the secretion was found to be coming exclusively from the middle lobe bronchus. A considerable quantity of this secretion was aspirated from the middle lobe bronchus. The left side, after the secretion was aspirated, seemed normal. No secretion reappeared. *Diagnosis.*—

Purulent tracheo-bronchitis with a large quantity of obstructive secretion in the right middle lobe bronchus.

There was immediate subjective relief following the bronchoscopic drainage, but the patient continued to expectorate thick, viscid, bronchial secretion for four or five days. Daily röntgen-ray examinations showed a progressive improvement of the aëration of the right lung and there was complete recovery at the end of seven days.

Allergic History.—Pollen sensitivity. For the past six years the patient has been extremely susceptible to attacks of bronchitis, but this susceptibility has existed for as long as he could remember. During the acute attacks there is marked dyspnœa, which frequently requires his assuming the sitting posture, especially at night when in bed. There are also marked symptoms of vasomotor rhinitis during the summer months. Dust increases the symptoms, also the smoke from frying meats and bacon. He has consulted a number of doctors at various times to be cured of his chronic cough and shortness of breath. He has had hives since childhood. While passing along a country road he will at times develop a violent poison ivy eruption.

Reaction.—Timothy—3 plus; Red Top—1 plus; June Grass—2 plus; House Dust—4 plus.

Case II.—C. M., male, white, single, twenty years, Italian. Admitted to Pennsylvania Hospital January 5, 1928, with diagnosis of right, indirect, incomplete inguinal hernia, which had existed for one year.

Operation January 7, 1928.—Under gas-oxygen anæsthesia a radical herniorrhaphy was done upon the right side by Doctor Lee. The following day the temperature began to rise, he developed a dry, harrassing cough, and at the end of forty-eight hours the clinical symptoms of massive pulmonary atelectasis of the lower lobe of the left lung had developed. The heart was displaced 3 centimetres to the left of its normal position. There was an ineffectual cough and he raised small amounts of a tenacious, thick, greenish sputum. Röntgen-ray examination demonstrated massive atelectasis of both lobes of the left lung.

January 9, 1928, at 5:45 P.M., approximately forty-eight hours after operation, Doctor Clerf with the aid of a bronchoscope found the left main bronchus completely filled with this secretion. Nine cubic centimetres were aspirated. The mucosa of the trachea and the right bronchus were inflamed. The secretion was not so thick or viscid as is usually found in this condition and was gray in color and filled with many air bubbles. A culture of pneumococci type IV and micrococcus catarrhalis was obtained from the bronchial secretion. Röntgen-ray examination made twelve hours after bronchoscopic drainage showed the heart to have returned to its normal position and the lung to be almost normally inflated.

January 26, 1928.—Röntgen-ray examination showed that all signs of atelectasis had disappeared.

Allergic History.—Diagnosis.—Bacterial sensitivity, vasomotor rhinitis. He has always been short of breath since childhood, and following exertion he would have to sit down frequently and rest for some time before he could breathe normally. He has considerable trouble breathing through his nose at all times, and when examined it was impossible for him to breathe through his nose.

Reaction.—Pollen and animal emanations were negative.

Case III.—D. D., male, white, twenty-four years, Italian. Admitted to Pennsylvania Hospital October 15, 1927 with left inguinal hernia.

Operation.—October 19, 1927, under gas-oxygen-ether anæsthesia a radical herniorrhaphy, left, was performed by Doctor Lee. There was more bronchial secretion than usual immediately after and on the day following operation and the cough was unproductive. Forty-eight hours after operation the patient was evidently having respiratory distress. Lips were cyanotic, there was decreased expansion on the left side of the chest, and a wooden-like impaired note posteriorly over the lower lobe of the left lung. Röntgen-ray examination showed a partial atelectasis of the lower lobe of the left lung.

October 22, 1927.—Bronchoscopic drainage was instituted by Doctor Clerf, which was followed by subjective improvement but not an immediate reinflation of the lung.

October 25, 1927.—The heart had assumed its normal position.

October 29, 1927.—The physical signs in the left lung were normal and röntgen-ray examination showed no evidence of atelectasis.

The patient was again admitted to the hospital September 19, 1929, with a right inguinal hernia.

September 21, 1929.—Under gas-oxygen anæsthesia a radical herniorrhaphy was done on the right side by Doctor Lee. The day following operation harrassing cough developed accompanied by a slight amount of yellow, viscid expectoration.

September 23, 1929.—The respiratory distress had not only persisted but increased, the cough was still unproductive and he complained of severe pain in the left chest. Upon percussion there was a dull note obtained over the entire left lobe posteriorly. The heart was displaced to the left, so that the right border of the heart was at the left lateral margin of the sternum, while the apex was found to be just outside of the mid-clavicular line. The röntgen-ray examination showed massive atelectasis of the lower lobe of the left lung, and fluoroscopic findings were characteristic and unmistakable of atelectasis.

December 12, 1929.—Röntgen-ray examination showed that the atelectasis had entirely disappeared and there was normal aëration.

Allergic History.—Diagnosis.—Pollen sensitivity. There was no history of hives, asthma nor hay fever. He has had a cough for about three years preceding the first operation. He describes his cough as a gasping for breath and that he had to sit up in order to obtain relief. There was no expectoration of any kind during these attacks. The cough started in June, 1926, and he was compelled to stop work about Christmas of 1926 because of it.

Skin Reaction.—Timothy—3 plus; June Grass—2 plus; Duck Feathers—3 plus.

Case IV.—S. S., male, white, single, seventeen years, Jewish. Admitted to Pennsylvania Hospital August 18, 1928, with diagnosis of chronic appendicitis.

August 18, 1928.—Under nitrous oxide-ether anæsthesia Doctor Kneedler removed an acutely inflamed appendix and the wound was closed without drainage.

August 21, 1928.—Patient's temperature had risen to 103° F., there was harrassing unproductive cough with rapid respiration. Inspection of the chest showed a marked diminution of expansion on the left side. The heart was distinctly displaced to the left. The right chest was hyperresonant throughout, both anteriorly and posteriorly, while the left chest showed signs of consolidation posteriorly over the lower lobe of the left lung. Röntgen-ray examination confirmed the clinical diagnosis, showing massive atelectasis of the lower lobe of the left lung.

August 21, 1928.—Doctor Clerf removed by means of the bronchoscope thick, yellow, purulent secretion from the trachea and both main bronchi, the greatest amount being obtained from the left main bronchus. Six cubic centimetres in all were aspirated. There were no abnormal secretions in the subdivisions of the right bronchus. In the left bronchus the secretions were sufficient to practically occlude the bronchial orifices. The entire tracheo-bronchial tree mucosa was acutely inflamed. The organism obtained by culture was Friedlander's bacillus.

September 7, 1928.—Final examination with the röntgen-ray showed normal aëration of both lungs.

Allergic History—Vasomotor rhinitis and animal emanation sensitivity. The patient has always had trouble with his nose and there has been marked coryza and he is subject to exacerbations of this condition when exposed to extremes of heat or cold. The mother and sister have had similar troubles with head colds. Patient has had this condition for some years.

Skin Reaction.—Sheep's Wool—3 plus; Cat Hair—2 plus; Milk—1 plus.

Case V.—M. A., female, white, married, fifty-nine years. Admitted to Pennsylvania

Hospital December 2, 1929 with diagnosis of chronic recurring catarrhal appendicitis.

December 11, 1929.—Under gas-oxygen anæsthesia an adherent and chronically inflamed appendix was removed by Doctor Lee, and the wound was closed without drainage.

December 13, 1929.—The patient had an attack of asthma during the night. She gave a history of having had attacks of asthma during the last five years. The following day the leucocytosis had risen to 21,000, temperature to 101°. Examinations by Doctor Lee and Doctor McMillan agreed in the finding of definite physical signs of atelectasis of the lower lobe of the right lung. There was displacement of the heart to the right, the apex being palpable in the right nipple line, and signs of consolidation were found posteriorly over the lower lobe of the right lung.

December 19, 1929.—Patient's temperature is normal and all signs of atelectasis have disappeared.

Allergic History.—Bacterial sensitivity. Following an attack of influenza in 1918 she developed asthma and this has continued since that time. The symptoms will appear after fatigue and especially upon catching cold. At first the attacks came on about every four months, but of late the intervals have shortened. The attacks last three or four days and she is usually confined to bed.

Skin Test.—She was found to be sensitive to the pneumococcus protein and has been treated with bacterin therapy with excellent results. Her father had asthma and the patient herself had a definite attack of asthma just before admission to the hospital for this operation.

Case VI.—E. F., male, white, single, eighteen years. Admitted to the Pennsylvania Hospital August 30, 1927, with diagnosis of acute appendicitis. Within an hour after admission the patient was given gas-oxygen anæsthesia and an acutely inflamed, gangrenous appendix was removed by Doctor Lee from the pelvic cavity. The wound was closed without drainage.

September 4, 1927.—Patient's temperature had reached 101° F. there was a dry, unproductive cough, cyanosis and dyspnœa. On physical examination the heart was found to be displaced to the left, and there were impairment and signs of consolidation over the lower lobe of the left lung posteriorly. Röntgen-ray examination showed massive atelectasis of the lower lobe of the left lung. Heart, trachea and mediastinum were displaced to the left. The upper lobe did not seem to be much involved. The right lung was distinctly emphysematous.

September 10, 1927.—Doctor Clerf by means of a bronchoscope found that the left main bronchus contained a yellow, tenacious secretion which filled the orifices of the upper lobe bronchus and also the lower lobe bronchus. The orifices of the bronchial subdivisions were occluded. Four cubic centimetres in all of the secretion were aspirated.

September 19, 1927.—Röntgen-ray examination shows the heart to be in normal position and there is complete aëration of the lung.

Allergic History.—Diagnosis.—Bacterial sensitivity. Patient has chronic eczema. He takes cold very readily. There are no nasal symptoms. Upon physical examination a few soft sonorous and musical râles are heard at the base of both lungs. It is difficult to obtain a history from the patient because of his poor mentality. He would not submit to tests; however, the presence of eczema definitely classes him as allergic.

Case VII.—C. E., male, white, single, fifteen years. Admitted to Pennsylvania Hospital July 26, 1928. Two days before admission he was seized with acute abdominal pain, and upon admission there was a definite mass felt in the right lower quadrant. Under gas-oxygen-ether anæsthesia, he was operated upon by Doctor Lee within an hour after admission, and an abscess containing one-half ounce of colon pus was evacuated and a gangrenous appendix removed. The cavity was drained with two cigarette drains.

July 28, 1928.—Forty-eight hours after operation there was a dry, hacking, unproductive cough, the right chest was definitely fixed and there was displacement of the right border of the heart toward the right. The lower right chest, particularly pos-

teriorly, showed all the physical signs of consolidation. Röntgen-ray examination confirmed the physical signs, showing a typical picture of massive atelectasis of the entire right lung. The diaphragm was high, the heart was displaced toward the affected side, and there was a to and fro motion of the mediastinal contents during respiration. The density was most marked in the right upper lobe.

July 28, 1928.—Doctor Clerf inserted the bronchoscope and found a secretion partially occluding the right middle and lower lobe bronchi. Six cubic centimetres of the secretion were aspirated. The mucosa of the right lower lobe bronchus was intensely inflamed. The left appeared normal. Pneumococcus type IV organisms were obtained from the bronchial secretion removed by Doctor Clerf.

July 28, 1928.—Röntgen-ray examination immediately after bronchoscopic drainage showed practically no change.

August 14, 1928.—Röntgen-ray examination this day showed a complete return of the heart to normal, and the lungs were normal except for a moderate peribronchial thickening on both sides.

Allergic History.—Diagnosis.—Pollen sensitivity. Patient has been perfectly well since operation. He has definite symptoms of vasomotor rhinitis, especially of the left nares. There has been marked difficulty in breathing through one side or the other of the nose for a long time. A sister has the same trouble and has definite hay fever. His attacks of rhinitis occur about every four or five months.

Skin Reaction.—Ragweed Short—3 plus; Orchard Grass—2 plus; Red Top—1 plus.

Case VIII.—C. L., male, white, age twelve years. Admitted to Germantown Hospital January 9, 1923, with diagnosis of appendiceal abscess. A short time after admission, under ether anæsthesia, Doctor Davis drained an abscess cavity containing colon pus and removed a gangrenous appendix from the patient's loin. Three days after operation acute pain in the right chest developed, accompanied with a fever of 101°, pulse 120 and respirations 32. He had all the signs of consolidation of the right lung and a primary diagnosis of pneumonia was made, but changed by Doctor Lee to one of massive atelectasis of the right lung. This clinical diagnosis was confirmed by Doctor Loughrey's röntgen-ray examination. Three days later Doctor Tucker introduced the bronchoscope and found thick, viscid, tenacious bronchial secretion occluding the right main bronchus, and aspirated some of it. The röntgen-ray examination made immediately after this aspiration showed a marked increase in the aëration of the lung. There was progressive improvement in the subjective and clinical symptoms, and a week after the first bronchoscopic examination and drainage a second one was made, when it was found that the bronchi were entirely free of the secretion which had caused the obstruction in the early stages. Röntgen-ray examination immediately after this bronchoscopic examination confirmed the normal position of the heart and the re-aëration of the lungs.

Allergic History.—Diagnosis.—Pollen sensitivity. Child's mother had violent asthma and hay fever, and the patient has a well-defined sensitivity to spring pollen.

Skin Reaction.—Timothy—4 plus; Red Top—4 plus; June Grass—4 plus; Sweet Vernal Grass—3 plus; Orchard Grass—3 plus.

Case IX.—I. R., male, white, single, twenty-nine years. Admitted to Pennsylvania Hospital November 25, 1929 with diagnosis of left inguinal hernia.

November 29, 1929.—Doctor Lee performed a radical herniorrhaphy under nitrous oxide-ether anæsthesia. The following day his temperature had risen to 102°, there was a dry, hacking cough and but slight expectoration of small amounts of a thick, tenacious, greenish secretion. The expansion of the right chest seemed much diminished near the apex.

December 4, 1929.—There were definite physical signs of consolidation of the left lung. The heart is displaced to the left and the röntgen-ray examination showed definite evidence of massive atelectasis involving both lobes of the left lung. The cough is

more productive today and large amounts of a thick, greenish, tenacious bronchial secretion are being expectorated.

December 15, 1929.—The chest symptoms have entirely disappeared and the heart has returned to its normal position.

Allergic History.—Diagnosis.—Pollen sensitivity. Patient gives a history of being subject to frequent head colds for the past two years. These occur especially in the fall. He is unable to eat eggs and has no desire for milk. The mother has frequent attacks of hives and hay fever.

Skin Reaction.—Timothy—3 plus; Red Top—2 plus; Sweet Vernal Grass—2 plus; June Grass—1 plus.

CASE X.—H. P., male, white, single, fifteen years. Admitted to Germantown Hospital February 23, 1926, with diagnosis of suppurative appendicitis. A short time after admission to the hospital he was operated upon by Doctor Lee under ether anæsthesia and a gangrenous appendix lying retrocæcally and retroperitoneally was removed. The abdominal cavity was drained with a small cigarette drain. During the anæsthesia there was an unusual amount of mucus. Following the operation the patient was cyanosed and could not be persuaded to cough.

February 25, 1926.—Twenty-four hours after operation the right side of the chest seemed to be immobile, while over the lower portion and posteriorly there were definite signs of pulmonary consolidation. Röntgen-ray examination by Doctor Loughrey showed massive atelectasis of both lobes of the right lung.

February 26, 1926.—Doctor Tucker introduced a bronchoscope and found complete occlusion of the lower and middle lobes of the right lung by tenacious secretion. About 20 cubic centimetres were aspirated. It was so thick that it could be completely inverted in the test tube without disturbing it. The left bronchus was perfectly normal and contained none of the secretion. The patient was somewhat more comfortable after bronchoscopy, but refused to cough or expectorate the secretion because of the abdominal pain which resulted. Upon being threatened with a second bronchoscopy the cough was somewhat encouraged, so that within two or three days it became more productive.

March 4, 1926.—Röntgen-ray examination showed a marked increase in aëration in the right lung, especially in the lower lobe.

March 20, 1926.—The heart had returned to its normal position and the lung was fully aërated.

Allergic History.—Diagnosis.—Animal emanation sensitivity. He has occasional coughs and colds, as stated in pre-operative history, and an uncle is subject to asthma and hay fever. On his paternal side, his grandmother has been a sufferer with asthma for years. One sister has vasomotor rhinitis and rose cold, with marked conjunctival irritation of the eyes. The patient himself experiences shortness of breath very frequently when in school and when he remains quiet for a long period. He gives a definite history of inability to eat fish in any form or of any kind, finding that it makes him violently ill, and he is convinced that beets affect him in the same way.

Skin Reaction.—Goose Feathers—1 plus; Duck Feathers—2 plus.

It is interesting to note that one year after the abdominal operation this patient had a mastoid operation and there were no pulmonary complications following this procedure.

In conclusion we wish to say that testing with all the proteins was not on the above-mentioned cases, as our only object was to prove by cutaneous tests that they were allergic to at least one or more irritants.

NOTE.—Since the reading of this paper Doctor Ashhurst has called our attention to the report of Montague Dixon, from the War Memorial Hospital, Melton Mowbray, England, in which he discusses the desensitization by peptone before laparotomy. In his search for an explanation of post-operative pneumonia, he was impressed with the fact that the acute lung conditions one sees in "general medicine" are commonly the result

of asthma, acute pulmonary œdema and massive collapse. "Might not the pneumonia which follows surgical operations be initiated by a lung change brought about by an influence similar to that which occurs in these medical cases? These changes are probably anaphylactic in origin, and the proteins obtained from the intestines."

It occurred to me, therefore, that it would be wise to try the effects of desensitizing patients with peptone before the operation. To this end I gave 0.3 grams of peptone and 2 centimetres of normal saline solution fourteen hours before the anæsthetic was given. Results were so encouraging that we have now adopted this treatment, in all abdominal sections in which there is time for such preparation, as a routine in our practice. No case which has had the peptone has developed pneumonia. There has been no other change in our method.

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PARTIAL RIB-REMOVAL WITH CLOSED DRAINAGE IN THE TREATMENT OF ACUTE EMPYEMA IN INFANCY AND CHILDHOOD

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If our series of 109 recent cases of empyema is like the general run of cases, this disease is relatively common in childhood. Almost one-half of our patients were children. The twentieth annual report of mortality statistics of the United States Department of Commerce [1] shows the death rate from uncomplicated pleurisy (forms not specified) to be between one-quarter and one-third of that from appendicitis. Empyema occurs relatively more frequently in childhood than appendicitis, and its mortality rate especially in infants makes its satisfactory treatment a formidable surgical problem.

It is true that empyema affects children and adults in a very similar manner, yet certain features of the physiology of the chest in childhood indicate that its rational treatment should differ somewhat at this age period and later ones. In the case of infants and young children the mediastinum is less rigid than in adults and therefore yields more readily to changes in pressure. Some adults, perhaps one-third of all, are able to suffer a sudden extensive open pneumothorax of one side without a collapse sufficient to produce death. Experience with soldiers wounded in the chest during the late war abundantly demonstrated this. In the case of children a large opening on one side will result fatally. Even after the pleura has become somewhat thickened from inflammatory changes, an opening in an infant's chest is much more hazardous than in the case of an adult's chest. The bearing of these facts on the mortality from open operation in childhood is obvious and should make the surgeon avoid early open operations.

Another feature of empyema very early in life is its unusually high mortality. This has not as yet been adequately explained. A child's seeming proneness to various complications may possibly throw some light on this problem. Of our four fatal cases, however, only one had any proven complication.

Another interesting point is the extremely low incidence of chronic empyema arising from acute empyema. Graham [2] states that he saw only two cases in two years in St. Louis, and that Hedblom, at the Mayo Clinic, had seen only eleven chronic cases in children in a total of 150 chronic cases. Out of forty-eight acute cases, we have never yet had a chronic case. This cannot be explained by a different type of organism affecting adults on the one hand and children on the other. In our cases the streptococcus hæmolyticus has occurred quite frequently in both, but twice as frequently in chil-

dren as in adults. It was considered by Dunham, of the Empyema Commission, as a very resistant organism, especially likely to produce chronic empyema; yet the children infected with it among our cases have not become chronically infected in a single instance.

Still another generalization which holds for the empyema of childhood, in contrast to that of adult life, is that the speed of anatomico-pathological processes is more rapid in the former. The empyema cavity will therefore, as a rule, be obliterated more rapidly and drainage should be discontinued sooner.

Keeping in mind these special considerations, we present briefly some facts which stand out as deductions from the study of forty-eight successive cases of empyema in children under sixteen years of age, all treated by the same method. Thirteen were infants, two years old or under. Obviously in a brief review it would be impossible to report these cases in detail. Suffice it to say here that abstracts of all the case records are at hand.

Etiology.—Pneumonia is by far the most common predisposing cause. It occurred in eleven of the thirteen cases of two years or under and was associated with measles and acute nephritis respectively in two of these. In the case of the two other infants, no cause could be found. Of the thirty-five cases over two years old, three had no cause assigned, twenty-eight had recently had pneumonia, one gangrene of the lung, one septicemia, one influenza without pneumonia, three whooping cough, and one measles. Three of the latter patients had more than one of these diseases.

We found only one patient who developed empyema as a primary process. This one deserves especial mention. He was five years old and was brought into the hospital with the diagnosis of appendicitis. His mother, who brought him, stated that up until twelve hours previous he had been perfectly well. While playing out-of-doors he had been suddenly seized with a cramping pain in his upper right abdominal quadrant and the family physician had thought of appendicitis. Upon examination on admission to the hospital the right chest showed signs of fluid and sixty cubic centimetres of thin pus were easily obtained by aspiration. Two hundred and fifty cubic centimetres of thicker pus were removed a few days later at operation. His recovery was rapid. In this case, the onset only twelve hours before and the absence of signs of pneumonia indicate that the pleura was the primary focus.

Coming now to the exciting causes, in the cases two years old or less, the staphylococcus aureus was present on culture in four cases. Pneumococcus of various types was found in six. Two cases gave no growth. For ages over two years, sixteen cases showed pneumococcus, seven streptococcus, seven streptococcus hæmolyticus. Staphylococcus aureus, bacillus coli, streptococcus non-hæmolyticus, and streptococcus viridans each occurred in one case. In six cases the cultures were not reported.

The age incidence in empyema of children is all important as a factor in determining the general mortality in any given series. The death rate is so much greater under two years than later. Of our forty-eight cases, thir-

teen, or a little under one-third, were under two years of age, seventeen were from two to five years, ten from five to ten years, and eight from ten to sixteen years.

*Treatment.**—In deciding upon the value of any method of treatment we feel that it should be tried out exclusively upon a number of cases for several years in different hospitals. The method here described is one of delayed partial rib removal and closed drainage. It has been applied to all of the forty-eight cases without exception. Patients from two different hospitals have been treated. Collectively the results of the series covers several years and are therefore not especially affected by temporary factors like epidemics.

Any discussion of treatment brings up what we regard to be the most important single modern contribution of the war to the treatment of empyema. This is the dictum not to operate immediately simply because fluid or even because pus is found. The feeling against early operation was probably gradually developed during the World War from the consideration of the futility of trying to save the lives of soldiers with influenza empyema by early surgical intervention. We feel that the already widely quoted report of the Empyema Commission [3] of the great reduction in mortality under delayed operation is especially pertinent in a discussion of empyema in children. The commission gives two main reasons against early operation: First, the danger of the collapse of the lung before protective adhesions have formed—a danger especially great in the case of children; second, the great danger of blood-stream infection from the absorption of organisms. Two cases are quoted by the commission in which blood cultures before early operation were sterile and twenty-four hours later positive for hæmolytic streptococcus. In other words, the early opening up of tissues by operation provided a ready means of spreading the infection.

Graham and Bell [4] of this commission, working experimentally on animals and human cadavers, have proven that for all practical purposes the thorax may be considered as one cavity instead of two. Furthermore they demonstrated that ten dogs, given streptococcus pneumonia and empyema experimentally and drained early, died in every case but one sooner than similar control dogs which were not operated upon.

Clinically we apply these findings in the following manner: We never operate on a child early, *i.e.* soon after fluid collects in the chest. If by aspiration fluid is obtained which is slightly cloudy and is found to contain a few pus cells we re-aspirate with a pump and bottle aspirator on alternate days and study the fluid with especial reference to the specific gravity.

In fifteen of the reported cases we have found that this becomes progressively higher as the fluid becomes more filled with cells and the products

* Dr. Joseph M. Flint, who introduced the closed method of treatment at the New Haven Hospital, suggested to the author that he make a special study of this method. Grateful acknowledgment is made of Doctor Flint's many helpful suggestions throughout the course of the work at New Haven.

of their degeneration. In these cases the specific gravity rose gradually from 1,017 to 1,029, at which latter point aspiration with a fairly large needle was impracticable on account of the fibrin present and operation was performed. In determining the specific gravity, on account of the high viscosity or thickness of the pus, we have found the Hammerschlag Benzine-chloroform method very accurate and convenient.

From the practical standpoint, we consider it the proper time to operate when with successive aspirations the fluid has become so thick that it may no longer easily be drawn through a needle, and the child meanwhile has built up his resistance to the organism.

The operation employed lends itself readily to local anæsthesia. Novocain one per cent. is used wherever possible. Many children with whom local anæsthesia would be very difficult on account of their nervous temperament may be won over if the surgeon makes it a point to be present at the aspirations or to do them himself. If, in spite of this precaution, difficulty is encountered it is safe to use nitrous oxide and oxygen.

The operation which we have employed in these forty-eight successive cases has been the subperiosteal removal of from three to eight centimetres of rib. The site of operation is as far forward toward the anterior axillary line and as low down as previous aspirations have shown pus to be present. The drainage tube is placed as far forward as possible in order to prevent the patient from lying upon and displacing it or pinching it off.

In studying the mechanics of the chest, we have found a homely apparatus very helpful. We call it an "artificial lung and pleural cavity." We have constructed this from a glass jar, a stopper with two perforations, an old rubber glove, and a piece of tubing. Anyone may easily find these materials if he should care to test out the principles involved. Let the rubber glove A (in Fig. 1, left) represent the lung, which we know is elastic. The bottle represents the thoracic wall. Then tube B will represent the primary bronchus, and C the drainage tube. If now a small amount of fluid (pus) be poured into the bottle as in Fig. 1, it will of course mainly sink to the bottom, only rising slightly along the glove (visceral pleura) by capillary attraction. If now suction be exerted upon the interior of the bottle through the drainage tube C (see Fig. 1, right) the glove will displace the contained liquid and it will be delivered through C to the last drop. The rubber glove representing the lung will be expanded and will fill the space even between the fingers (interlobar fissures). No matter how small a quantity of pus is introduced, it will be delivered through the drainage tube C, even though its opening is far above the general level of the fluid. If a mercury gauge is connected to the outlet system, the negative pressure required to empty the artificial pleural cavity will be equal to the elasticity of the artificial lung plus the equivalent of the length of a column of the fluid from its upper level to the drainage tube.

Binnie[5] says, "I feel strongly that in empyema, the chest should be opened at the angle of the seventh, eighth, or ninth rib and after slow

evacuation of the pus the finger should explore the cavity and find that point which will be low both for the erect and recumbent postures. At this low point free drainage will be established." In backing up this argument for a second or counter opening, he quotes Chevrier,[6] who demonstrated on the cadaver that an opening through the sixth rib in the post-axillary line permitted the retention of 650 cubic centimetres of fluid in the recumbent posture, and 1,250 cubic centimetres in the erect, while figures for an opening at the eighth rib and scapular line were 300 cubic centimetres and 200 cubic centimetres respectively.

Binnie's contentions for a low drainage site are perhaps well taken where open drainage is used. His quotation shows the futility of trusting to a

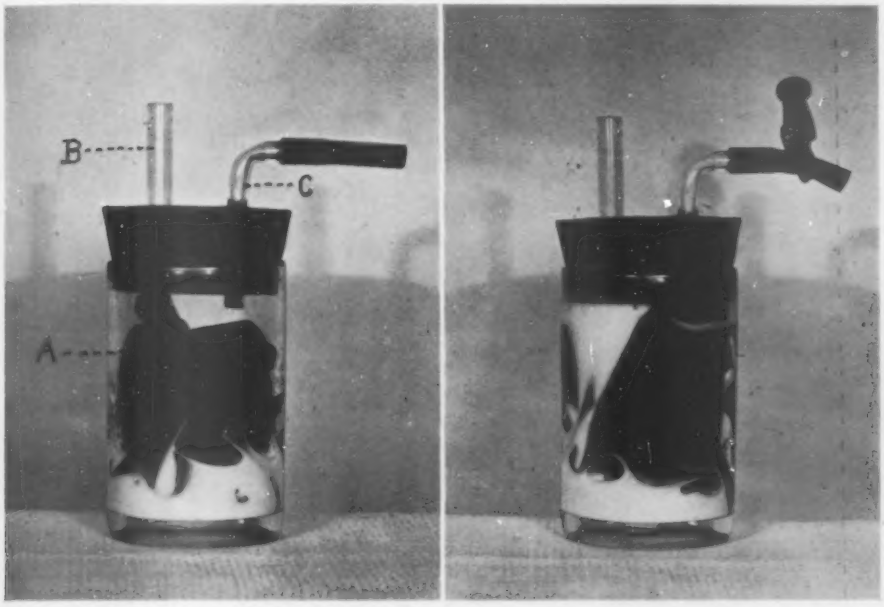

FIG. 1.—Illustrating the value of negative pressure in a closed system for draining empyema. For explanation see text.

method of open drainage to *drain the chest efficiently at any site.* We do not wish to appear dogmatic, but our experimental apparatus indicates to us that with such a method we will either get overflow drainage or we will aspirate air through the sinus in order to replace the fluid draining out. The latter is hazardous because of the almost inevitable secondary infection which occurs.

With respect to the proper drainage site our conclusions therefore are:

1. With suction in a closed system no matter how high the pleural opening is made, the fluid will drain out.

2. Knowledge of these facts should keep surgeons from being overanxious to drain at the lowest possible site, and should therefore prevent such accidents as perforation through the diaphragm into the abdominal cavity.

Three cases of peritonitis arising from this cause were reported in this country only two years ago.

To continue with the question of operation once the portion of rib has been removed, the periosteum and pleura are divided and the empyema cavity gently and thoroughly explored with the examining finger. Care is taken to rid the pleural surfaces of all fibrin coagula. These often take the form of large chunks or plugs. Sometimes, by placing warm normal salt solution in the cavity, these will float up to the incision and may be removed. Care must be taken not to have the salt too hot and to keep the opening plugged with gauze most of the time. These precautions are both taken to prevent coughing and straining from reflex pleural irritation.

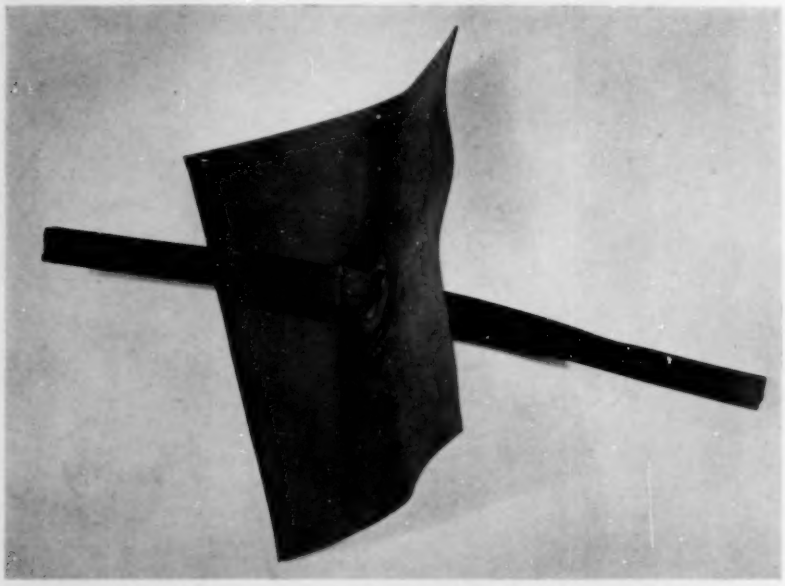

FIG. 2.—Rubber drainage tube with dam attached for sealing it hermetically to the chest wall.

The remainder of the operation is simple, consisting of closely suturing the periosteum, subcutaneous tissues and skin in layers about a single fenestrated tube one to two centimetres in diameter extending to the depths of the cavity, and having attached to it a small rubber-dam, shown in Fig. 2, which fits closely to the skin about the tube. A small amount of "K. Y." jelly is placed between the skin and the dam and the latter is strapped down with adhesive.*

Following operation, the drain tube is connected with a pus trap and this in turn with two ordinary water bottles arranged in the usual way for siphon drainage. The suction should be maintained constantly by keeping

* Rubber-dams with drainage tubes attached may be obtained in small and medium sizes from The Baumann Rubber Company, 492-494 Congress Avenue, New Haven, Connecticut.

the upper bottle filled with water from the lower as often as it runs out. With tight connections one change of water will last for several hours. One bottle should be about twenty-four inches above the other to give the proper negative pressure. In some hospitals negative pressure is available in all the wards through a suction pump. In these a mercury gauge must be used. The pus trap should have its contents measured and the amount recorded each day. After about seven to nine days, when the amount has markedly decreased, the tube is temporarily removed, shortened, and then re-strapped to the chest. It is then shortened every three days until by X-ray and physical signs no fluid is found to be present. A small tube transfixed by a safety pin is then placed in the opening and healing usually soon occurs. If after the pleura is closed the superficial wound is slow in healing, Dakin's solution is employed to aid in its sterilization.

After operation careful dieting with intermediate feeding and forcing of fluids should be employed in all cases, since many of the children are very emaciated. We encountered a secondary anæmia in several children which is very refractory to treatment. In these cases sodium cacodylate and transfusion of blood have been of great value.

The method of partial rib resection and closed siphon drainage which we employ has the following advantages over open drainage methods: (*a*) it absolutely avoids the danger of open pneumothorax which may be fatal; (*b*) it makes a low opening for dependent drainage unnecessary; (*c*) it does away with the inconvenience of frequent dressings and the danger of secondary pleural contamination from the skin; (*d*) it eliminates the development of chronic empyema from acute cases; and (*e*) it gives an extremely low mortality rate in children of all ages.

We have never found it necessary to irrigate an acute empyema with Dakin's or other solutions. Though other authors do this, we have found it unnecessary and therefore inadvisable. Results have been better without it. In a certain percentage of cases especially in children, the sensitive pleura will be dissolved by the hypochlorite solution and a broncho-pleural fistula will result from its use.

Out of the forty-eight cases treated by this method of suction drainage only four died.

ANALYSIS OF FATAL CASES

Case I.—The patient, aged twenty months, gradually declined and died one month after operation. The cause was not definitely explained, since there was no autopsy.

Case II.—The patient, an infant of eighteen months, became gradually weaker and died ten days after operation. No autopsy.

Case III.—A child of three years was unconscious before operation. Death came twenty-four hours later. Autopsy not granted.

Case IV.—Child, aged six years, had whooping cough, broncho-pneumonia, and stomatitis preceding operation. At autopsy no free pus was found in the pleura, only a patch of fibrin and purulent exudate, about 2 centimetres in diameter at the left apex near the mediastinum. A fibrinous pleurisy was also found in the opposite chest.

The last seven children of the series were treated at Vanderbilt Hospital. Two were under two years and five over this age. All were cured by partial removal of a rib and suction drainage by the closed method. No chronic cases developed from these.

COMPARATIVE RESULTS

Our purpose throughout this study has been to apply a certain system of treatment to all of the cases for a considerable period of time in two different hospitals in order to determine the effect of its exclusive employment upon mortality and chronicity. Table I shows the encouraging results which we have obtained by this system.

TABLE I

Results of Treatment as Related to Age Periods. (Author's Series)

	Age	No. of Cases Treated	Deaths	Mortality	Chronic Cases (Developing from Acute)
New Haven Hospital 1919–1922 and Vanderbilt Hospital 1925–1928	Under 2 years	13	2	15.4%	0
	Over 2 years	35	2	5.7%	0
	Under and over 2 years	48	4	8.3%	0

While it is certain that such factors as epidemics and the nature of the causative agent and its virulence may, for a time, affect results considerably, yet such factors should logically average up in the length of time covered by ours and by all of the series enumerated in the tables. For example, our results embrace one influenza epidemic. Likewise, culture reports show that our cases have been caused by approximately the same organisms as those reported by other authors.

Statistical studies are often misleading, yet it is evident that the figures quoted in the tables from a number of large reported series covering several years should at least convey a fair impression of results obtained throughout the country. Excluding the unusually high mortality figures from the Babies' Hospital of New York prior to 1913, the average mortality for 276 infants under two years in the various hospitals listed in Table II is found to be 31.4 per cent., while that for 280 children over two years is 15.5 per cent. Our figures of a 15.4 per cent. mortality for infants and of 5.7 per cent. for children are considerably lower than these.

In closing we emphasize one point. Among forty-eight cases there was not a single instance of chronic empyema developing from an acute case. The cured cases were proven cured of empyema by long-time follow-up examinations with re-checks by X-rays. So far as we have been able to find out from the literature, not a single series of this size even in children has been reported without chronic cases, Graham reporting two in his series and Bohrer and Ladd and Cutler reporting several in their series.

SUMMARY AND CONCLUSIONS

1. Three points render the study of the treatment of acute empyema in children especially important: (*a*) the high incidence of the disease under sixteen years as compared with that of the combined ages above sixteen; (*b*) its unusually high mortality rate in infancy; (*c*) the fact that chronic empyema arising from acute in children should be considered in the light of a preventable disease.

TABLE II
Result of Treatment as Related to Age Periods
(Series of Other Authors)

Source	Age	No. of Cases Treated	Deaths	Mortality	Chronic Cases (Developing from Acute)
Babies Hospital of New York City Prior to 1913[7]	Under 2 years	167	109	66.8%	
	Over 2 years	37	5	13.5%	Not reported
Mount Sinai Hospital, New York City 1903–1913[8]	Under 2 years	111	42	37.8%	
	2 to 10 years	89	15	16.7%	"Not infrequently"
St. Louis Children's Hospital Sept., 1919 to Sept., 1921	Under 2 years	12	2	16.6%	
	Under and over 2 years	34	4	11.7%	5.8 per cent
Bellevue Hospital, New York City 1920–1924[10]	Under 2 years	48	17	34.8%	2.4 per cent (exclusive of tuberculosis)
	Over 2 years	154	26	16.8%	
Children's Hospital, Boston Prior to 1924[11]	Under 2 years	48	17	35.4%	11.5 per cent (requiring secondary operations)
	Over and under 2 years	268	52	19.3%	
Johns Hopkins Hospital 1889–1927[12]	Under 2 years	48	19	39.6%	Not reported
Johns Hopkins Hospital 1927–1929[13]	Under 2 years	9	2*	22.2%	Not reported
	Under and over 2 years including a few adults	30	4	13.3%	

* One of these was removed from hospital against advice before death.

2. In the present series the use of irrigations with antiseptic solutions was purposely avoided. The low mortality and complete absence of chronicity obtained without them indicate that they are not necessary in the successful treatment of acute empyema.

3. The system described for the treatment of acute empyema consisting of partial rib removal and sealed siphon drainage is simple enough to be generally used and has yielded results with forty-eight children including thirteen infants, which should commend it to the profession at large.

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PHRENIC EXAIRESIS IN THE TREATMENT OF PULMONARY TUBERCULOSIS*

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The time-honored and established methods of treatment of pulmonary tuberculosis by rest, fresh air and sunshine, and good food have been augmented in recent years by the employment of certain surgical procedures. These surgical methods have not displaced the older regimen but rather are used in conjunction with it. Carson [1] of England advised surgery in the

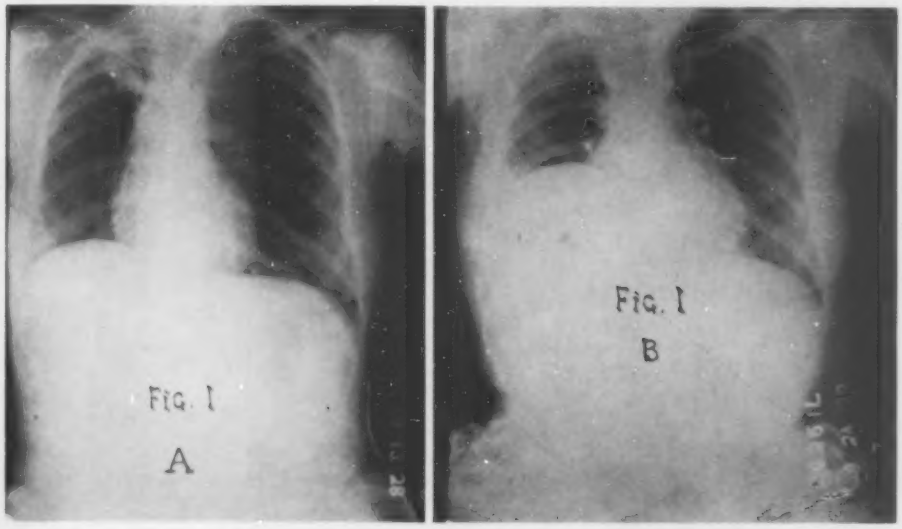

Fig. 1.—J. P., female, aged twenty-six years. Under observation since 1926. Far advanced pulmonary tuberculosis. After three admissions to sanatorium condition became quiescent. Sputa remained positive for tubercle bacilli. She had frequent colds in head and chest following her discharge from the sanatorium. Chest always had many râles and a bronchitis persisted throughout right upper. After operation moistures gradually cleared and lung is now dry for the first time.

treatment of pulmonary tuberculosis as long as one hundred years ago. It was not, however, until 1894 that Forlanini [2] of Pavia first used compression therapy in the form of artificial pneumothorax. J. B. Murphy [3] in 1898, working independently of Forlanini, developed the same idea. This method, however, did not come into routine use in the United States until 1910 or 1912.

There are two methods of compression therapy, the first, pneumothorax, and the second, section of the phrenic nerve combined with thoracoplasty. This procedure reduces the volume of the lung three hundred to one thousand

* Read before the Southern Surgical Association, December 10, 1929.

cubic centimetres. Steurtz [4] first suggested phrenicotomy for lower lobe tuberculosis in 1911 and German observers have reported that the lung volume is cut one-fourth to one-third its capacity by phrenic exairesis.

Unfortunately section of the phrenic nerve or phrenicotomy did not produce results in all cases. This was due to the fact, as was demonstrated by Felix in 1922, that the phrenic nerve often gets branches from the nerve to the subclavius muscle and also possibly from the hypoglossal, spinal accessory, vagus or suprascapular nerve through the ansa-hypoglossi. What is more important is that frequently the phrenic nerve is duplicated in the neck. We have seen a number of cases in which there seem to be nerve fibres coursing in the same direction as the phrenic nerve and yet outside its sheath. This

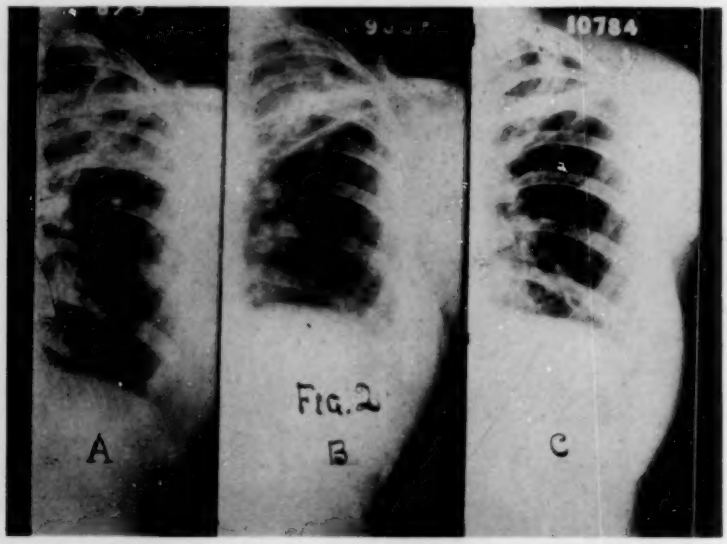

FIG. 2.—L. P., female, aged thirty-eight years. Pulmonary Tuberculosis far advanced; no pulmonary changes following three months' rest in bed (Fig. 2A). Tuberculous laryngitis healed, general condition improved. Phrenicectomy done as a preliminary to pneumothorax. (Fig. 2B.) One month after operation one cavity had disappeared and two others were reduced 50 per cent. Five months later (Fig. 2C), cavities no longer visualized and all sputa negative for tubercle bacilli.

accessory phrenic nerve may lie as far as three centimetres lateral to the true phrenic and goes along with the nerve to the subclavius muscle. This accessory phrenic passes in front of the subclavian vein while the true phrenic goes behind it. Lower in the thorax these two nerves join. According to Felix [5] there is a double phrenic in 20 to 25 per cent. of cases. Goetze [6] found 68 per cent. had accessory nerves and it was Ruheman's [7] observation that 64 per cent. were abnormal.

To overcome this double enervation of the diaphragm two operations were devised: Goetze divided the phrenic nerve low in the neck and also cut the nerve to the subclavius muscle. This procedure is difficult and has fallen into disfavor. The second method, namely of avulsion of the phrenic nerve, was suggested by Thiersch [8] and first done by Willie Felix. This is the

method which is commonly used today and is the one that we have used in all except a very few cases. In these there were large vessels crossing the nerve trunk and as traction was made on the nerve these vessels were pulled into view. Fearing that with further traction the vessels would tear we were satisfied to section and remove two or three centimetres of the nerve trunk.

The advantage of avulsion is that the nerve may be taken out in its entirety or, if not, that enough may be obtained to break the connections with the accessory phrenic and so obtain complete (diaphragmatic) paralysis. Alexander [9] is of the opinion that the union with any accessory branches occurs in the upper twelve centimetres of the phrenic nerve and therefore total paralysis of the diaphragm would be expected when that amount of

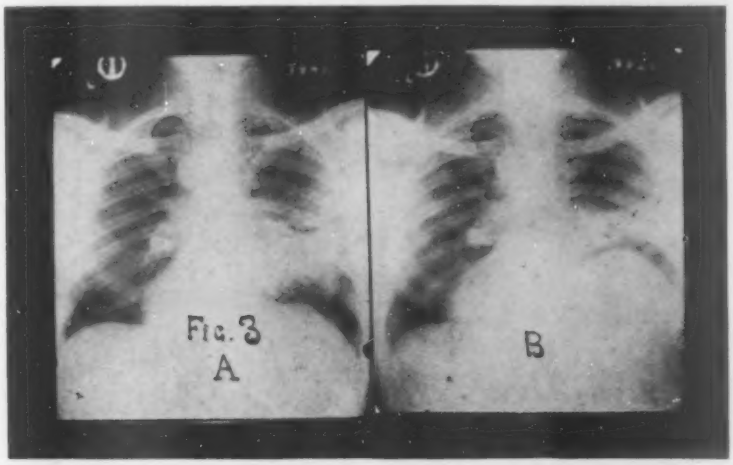

Fig. 3.—J., negro, male, aged fifty-four years. A.—Basal tuberculosis, sputa positive for tubercle bacilli. Phrenicectomy, February, 1929. Fig. 3B, four months later, shows rise of diaphragm, compression of lesion, and absorption taking place. Sputa negative for tubercle bacilli and patient is symptom free.

nerve is obtained. That the location of the union of the accessory and true phrenic nerves is not constant has been shown by Goetze who found one case where the junction occurred three centimetres above the diaphragm.

We first began our work in this field in August, 1926, at which time we did an avulsion on the left phrenic nerve in a young man who had been in a sanatorium more than three years and whose disease was approximately at a standstill. The result in his case was most gratifying and since then we have done this operation on more than a hundred and twenty-five patients. We have carefully studied these individuals and fortunately have been able to follow most of them. It is our purpose to review a hundred of these cases and show what results may be expected from this method of treatment.

Of one hundred patients operated by phrenicus exairesis, thirty-nine were males and sixty-one females. There was no appreciable difference in the two sides as to incidence, forty-five being on the left and fifty on the right—in five, the side was not recorded.

In this series fifty-four were candidates for artificial pneumothorax; in fourteen this had proved unsuccessful, due to adhesions, and in seven the treatment was discontinued; in some because of adhesions, and in others the lung was to be permitted to reëxpand or was permanently atelectatic. In thirty-two a more or less satisfactory pneumothorax had been induced some time prior to the nerve operation. While clinical improvement was the rule, recovery was uncertain, due to uncollapsed cavities, positive sputum, adhesions, and flexible mediastinum. In the pneumothorax cases subjected to phrenicectomy, the amount of collapse was increased in fourteen and uninfluenced in fourteen.

It was interesting to note that ten of the cases of pneumothorax developed fluid in the pleural cavity immediately after the operation. We are not sure

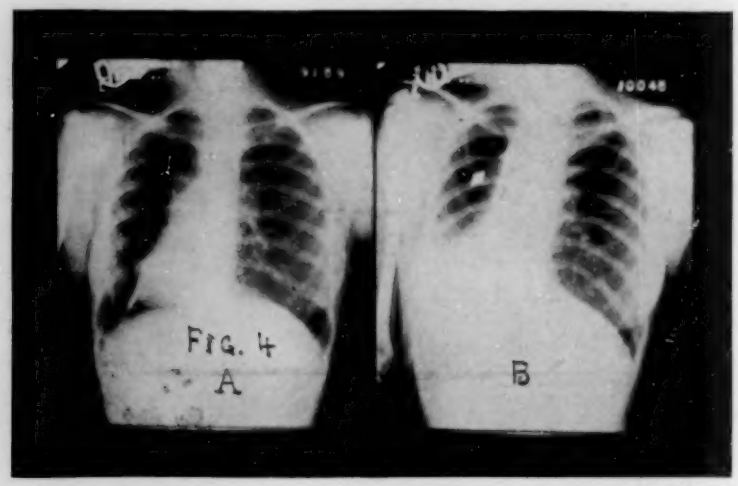

FIG. 4.—J. P., female, aged fourteen years. Admitted September, 1927, age twelve, with far advanced tuberculosis. Had profuse hæmorrhages and all sputa positive. Hæmorrhages recurred from time to time. Pneumothorax induced April, 1928. Last hæmorrhage June, 1928. Cavity uncollapsed, but sputa negative for tubercle bacilli. Following phrenicectomy May, 1929, cavity became obliterated. Fig. 4B—Two months after operation.

whether this is a coincident or not, but we are inclined to believe that it is induced by the avulsion. It occurred in none of the other cases. For this reason we prefer in those selected for pneumothorax, to do a phrenic avulsion first, whenever this is indicated.

Observations on cavities were made in forty-four patients; included in these are those with and without pneumothorax. These disappeared in eight, became less in sixteen, and remained the same in twenty. The elevation of the diaphragm was determined from X-ray films and fluoroscopic examination. It was considered as marked elevation when the ascent equaled two or more interspaces, moderate with an elevation of one interspace, and slight when the rise was less than one interspace. We were able to carry out this observation in all but fifteen patients. The diaphragm showed marked elevation in twenty (at times reaching to the third rib anteriorly); moderate elevation in twenty-nine; slight in fourteen, and no ascent in twenty-two. Fluoroscopic

observations on sixty-eight patients revealed the diaphragm fixed in fifty-eight and mobile in ten. Even where there was no rise of the diaphragm, fixation was the rule. This is a point not sufficiently emphasized and is an important factor in resting the lung and bringing about improvement.

It is interesting to note the effect of phrenicectomy on expectoration; the uniform report was that "it came up easier," and one patient stated that it literally rolled out of his mouth. In some few the sputum was later difficult to raise, particularly when it became scanty.

Reports are available on fifty-six patients, in whom the sputum became less in twenty-two; remained the same in twenty-one, and was increased in thirteen. The increase was temporary in most of these and later became lessened. In eight, with and without pneumothorax, the sputum which had been

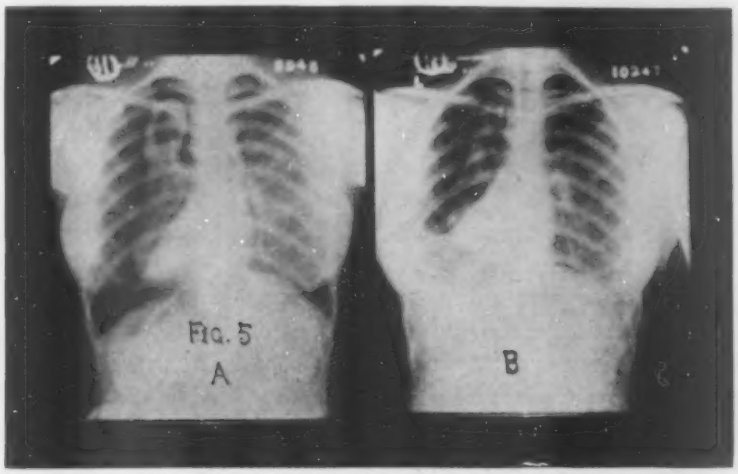

Fig. 5.—M. L., female, aged eighteen years. Artificial pneumothorax begun September, 1928; moderately high pressure (plus 5 to plus 6 half values) failed to collapse large cavity in apex. Following phrenicectomy May, 1929, diaphragm has risen, Fig. 5B, and relieved tension on lung, permitting complete closure of cavity. Three months after operation.

persistently positive for tubercle bacilli became negative. Similar findings obtain for cough, which became less in twenty-two, uninfluenced in twenty-one, and increased in thirteen.

We were particularly interested in dyspnœa and tabulated the findings in sixty-six patients. There was no dyspnœa in thirty-one; slight and transitory in eighteen; moderate and of short duration in eleven; and marked dyspnœa in six. The dyspnœa was aggravated or more noticeable when lying on the back; due to the greater elevation of the diaphragm in this position. In one patient, near the fifth decade, there was slight dyspnœa prior to operation, due partly to a mild emphysema, this was increased by operation and has persisted. The most marked dyspnœa occurred in a woman, which necessitated her sitting up in bed most of the time. The dyspnœa appeared to be due to the marked paradoxical breathing on the paralyzed side. In the course of several months, this has slowly improved. (Figs. 1–5.)

In estimating results one must take into consideration the reasons for phrenic exairesis in each individual case, and the objective sought. If avulsion were induced as a safety factor in an already well-established pneumothorax the condition remained unchanged; many were symptom free and in these no appreciable change would be expected. In the latter group twenty-three patients are included. Of those who remained unimproved or worse there were twenty-four; definite improvement was recorded in forty; and in six sufficient time has not elapsed to warrant any conclusions. Of those who succumbed to their disease, there were seven, but in none of these was their demise traceable to the operation.

The following are indications as applied to our work at Waverly Hill Sanatorium and have been considerations which have led us to operate on the foregoing cases. These do not cover all the indications for phrenicectomy.

We have used it in one case of pulmonary hæmorrhage where artificial pneumothorax failed, without result—the patient continued to bleed and subsequently succumbed.

Where intrapleural pneumolysis is indicated, we would personally prefer to attempt closure of a cavity by phrenicectomy first.

Indications.—1. As a preliminary procedure in artificial pneumothorax, especially when cavities are moderately thick-walled, and where the pneumothorax will be carried indefinitely.

2. As a preliminary procedure to artificial pneumothorax when the cavities are thin-walled and situated in the infraclavicular region. Phrenicectomy under these circumstances may result in a complete closure of cavities and pneumothorax be unnecessary.

3. In moderately advanced pulmonary tuberculosis that has shown no improvement following three months' routine bed rest.

4. In patients clinically well who have a unilateral lesion and a persistently positive sputum, in the absence of definite cavitation.

5. In all lower lobe tuberculous lesions, or in those cases where the pathology is predominantly basal.

6. As a preliminary operation to thoracoplasty.

7. In those individuals, who, by reason of temperament, or lack of normal intelligence or self control, are unable to bring themselves to undergo routine sanatorium care, and the prolonged fight and self-denial necessary for recovery, phrenicectomy is helpful.

8. In acute and progressive pulmonary tuberculosis, phrenicectomy may slow the progress and initiate improvement. The negro falls within the latter two indications. Our mortality rate for negroes at Waverly Hill Sanatorium fluctuates between 43 and 61 per cent. Artificial pneumothorax has been unsuccessful in the negro in our hands. With a reasonable selection of patients phrenicectomy offers possibilities for the negro. Cases must be selected in the early stages of the disease if recovery is to be expected. Eight negroes, not included in this series, submitted to phrenicectomy; all were far advanced. Of the six women, three have died, and three are im-

proved; of the two men, both have improved and one has had a continuously negative sputum since operation.

Basal tuberculosis occurs frequently in the negro and in these phrenicectomy, is particularly indicated.

9. As an adjuvant in artificial pneumothorax where cavities remain uncollapsed in the presence of a satisfactory pneumothorax, the relief of tension may bring about closure. This happened in six of our cases.

10. In patients with positive sputa, despite good collapse, and where no cavities are observable in the collapsed lung.

11. In those cases where pneumothorax must be kept up indefinitely, phrenicectomy adds a margin of safety and lessens the number of refills.

FIG. 6.—Exposure of left phrenic nerve through transverse incision. The sheath of the anterior scalene muscle has not been divided.

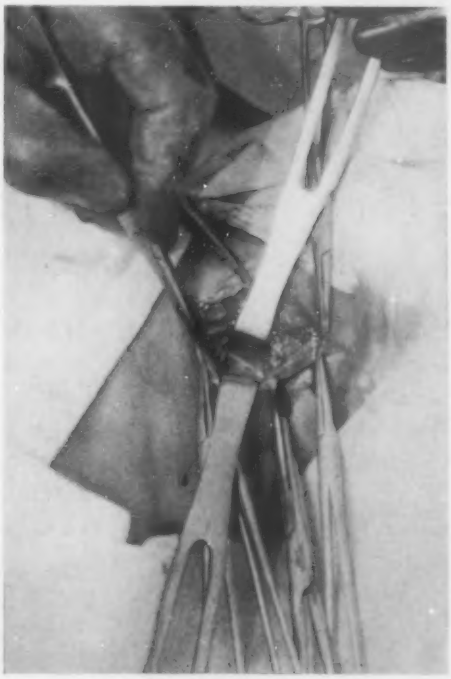

FIG. 7.—Phrenic nerve exposed through longitudinal incision along posterior border of the sternomastoid muscle.

12. As a final procedure where one is considering discontinuing an artificial pneumothorax and permitting the lung to reëxpand, especially if there was preëxisting cavitation.

13. Where pneumothorax is being lost due to adhesions.

14. In artificial pneumothorax complicated by a flexible mediastinum, a successful phrenicectomy tends to increase collapse without resorting to high pressures, thus minimizing the tendency to displacement of the mediastinum.

15. As a supplemental procedure in most cases of artificial pneumothorax.

Operative Technic (Figs. 6 and 7).—We have varied our method of approach to the phrenic nerve depending upon the sex of the individual. In

women we make a transverse incision about two and one-half centimetres above the clavicle and about three centimetres long, having its mid-point at the outer edge of the sternocleidomastoid muscle. This muscle is extracted inward, exposing a fat layer in which are a few lymph nodes and several small blood vessels. This layer is separated by careful blunt dissection and the anterior scalene muscle exposed. Care should be exercised not to incise the sheath of this muscle as the nerve may then be displaced with the sheath, so delaying the exposure of the nerve. Furthermore hæmorrhage should be avoided for it obscures colors, making the identification of the nerve more difficult. In some of the men we have used a vertical incision along the posterior border of the sternomastoid. This gives a little better exposure, but on account of the scar we have preferred the transverse incision in women.

In most cases as the anterior scalene muscle is exposed the phrenic nerve will be seen coursing from without downward and inward. At times we have located the nerve on the inner aspect of this muscle, more rarely it is on the

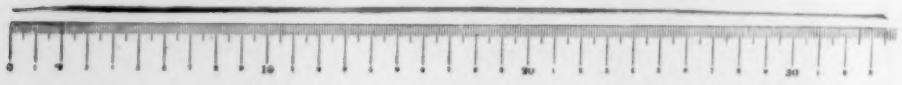

FIG. 8.—A full length of the phrenic nerve obtained from one patient. The cervical end of the nerve is at the 33-centimetre mark. The thickening at the left hand end shows where the branches were given off.

outer surface, and occasionally is located within the muscle itself. When the nerve has been exposed it is injected with 2 per cent. novocaine, sectioned and the distal end gradually twisted out. We have often avulsed thirty to thirty-five centimetres of nerve (Fig. 8) but more frequently the nerve breaks after twelve to fifteen centimetres have been withdrawn.

We believe that in those patients in whom the adhesions about the apex of the lung and mediastinum are very dense the nerve tears more easily and so the full length of the nerve is not obtained.

With the complications of phrenic exairesis we have fortunately had no experience. They have been listed by Bettman [10] as the following: injury to the thoracic duct, injury to the brachial plexus or cervical sympathetic, and hæmorrhage from the tear of a large vessel. This last complication usually results from the pull of the accessory phrenic. The surgery is not difficult but at times is tedious and should not be attempted by one who is not familiar with the anatomy of the neck and surgery of this region.

Comment.—Phrenicectomy is a valuable adjuvant in the treatment of pulmonary tuberculosis in selected cases. From observations in well over one hundred patients, we are forced to the conclusion that the operation will pass through the experience accorded artificial pneumothorax. This first was applied to terminal stage cases, later induced in earlier stages and finally was applied in minimal phases of the disease in selected cases.

In 90 per cent. of our cases the disease was far advanced and in many there was involvement in the contralateral lung of varying extent.

In Bridge and Bly's [11] series recently reported, 85 per cent. were also

third-stage cases. We are in accord with Alexander's [12] opinion that the operation should be performed in early cases that fail to show any response to routine sanatorium treatment.

It is quite possible that the part played by the diaphragm in respiration has been exaggerated. Sewall and Pollard [13] affirm that costal respiration is more effective than diaphragmatic breathing, basing their conclusions on vital capacity observations. The average volume for diaphragmatic breathing was 1341 cubic centimetres and for costal breathing alone, the average volume was 2139 cubic centimetres. Mosso's [14] experiments on himself parallel these, 1350 cubic centimetres for abdominal respiration and 2025 cubic centimetres for thoracic respiration. The subsidiary rôle played by the diaphragm is further evidenced by the bilateral phrenicectomies done on dogs [15] and man [16] without bad effects. The reduction in lung volume has been variously estimated as one-sixth to one-third. Berard and Guilleminet [17] reporting on two hundred and forty cases before the Academy of Medicine, France, estimated a lung reduction of one-fifth to one-fourth. Reduction in lung volume, while essential to the closure of cavities, is not the only factor in bringing about recovery; fixation of the diaphragm with resultant rest for the lung contributes much to the amelioration of symptoms and the clearing of the lung fields. For this reason adhesions in the costo-phrenic sinus are not a contraindication. For in some of our cases not only did fixation occur, but in a few marked elevation as well was observed. This was also noted in Mayer and Leetch's [18] series.

CONCLUSIONS

1. Phrenicectomy is a valuable aid in the treatment of pulmonary tuberculosis in selected cases.

2. Of one hundred patients so treated, 90 per cent. of whom were far advanced, 40 per cent. showed improvement; in eight the sputum became negative for tubercle bacilli; and in eight the cavities disappeared.

3. Phrenicectomy is an adjuvant in artificial pneumothorax, and should be considered in every case with cavitation; following avulsion of the phrenic nerve 44 per cent. of our cases showed a better collapse.

4. Phrenicectomy is not a substitute for pneumothorax, but when done as a preliminary procedure, in a small percentage, it will render collapse therapy unnecessary.

5. A good phrenicectomy is better than a poor pneumothorax; it is less hazardous; less discomforting; unattended with complications, and is a necessary preliminary to thoracoplasty.

The good results of phrenicectomy are not dependent on the location of the pathology, but rather on the retractibility of the pulmonary tissue. Basal and mid-lobe lesions offer most, and cavities above the clavicle least, although in the latter with a marked elevation of the diaphragm good results are obtained.

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TRAUMATIC DIAPHRAGMATIC HERNIA

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Every case of left-sided gunshot or stab wound of the chest, or crushing accident of the trunk, may be one of potential diaphragmatic hernia. Given a wound of the diaphragm, the force of aspiration of the thorax is exerted upon the freely movable abdominal viscera. The constant suction action of the thorax due to the negative pressure therein is aided by the entrance of the omentum into the opening which adheres there and prevents union of the edges of the opening, as does also the normal movement of the diaphragm in respiration. Adhesions of the adjacent abdominal viscera, most commonly the stomach and the thoracic viscera, form, and upon contraction of these adhesions the abdominal organs are dragged upward. In small openings this process is a slow one; in large rents from crushing injuries the abdominal viscera *in toto* may enter at once. With long-standing cases the pleura may form exudates which descend into the abdomen and increase the intra-abdominal pressure. A hernial sac rarely forms, the herniating viscera or viscus passing through the hole. The hernia is usually on the left side, as any wound of the right dome of the diaphragm is plugged by the compact and plastic liver, this preventing the movable viscera from entering the right side of the thorax.

The stomach is most commonly the organ which herniates. Giffen claims that a portion of the colon usually accompanies it. The colon is next in frequency to the stomach, while less often the omentum, small intestines, spleen, liver, pancreas, and kidney, are found in the thorax. The stomach usually ascends posterior to the lung, displacing the heart to the right, and crowding the lung toward the mediastinum, until it may become entirely functionless.

There is a wide variation of symptoms, from mild digestive disturbances to marked interference with the heart action. Hæmorrhage and pneumothorax, with collapse of the lung, may occur at the time of the injury, and death result in twenty-four hours. If the patient survives, dyspnœa and gastro-enteric disturbances occur from time to time, without apparent cause. Cyanosis and cough from cardiac displacement and pressure may be present. Anorexia may be persistent. There may be a feeling of fullness after meals and attacks of colicky pain. Pain may be complained of in the upper left quadrant on rising, and a sense of suffocation on lying down. The symptoms often simulate irregularly those of peptic ulcer or cholecystitis with hæmorrhage. Substernal or epigastric pain is probably the most common symptom, and the pain may radiate to the thorax anteriorly, to the back or to the left shoulder. The patient may suddenly develop nausea, vomiting,

constipation, dyspnœa and cyanosis, due to strangulation of the herniated viscera, and death follows unless relief is obtained early. The physical signs are variable and puzzling. The condition has been mistaken in acute cases for pneumonia by competent internists. Naturally the signs vary according to the amount of food, water and air in the stomach and bowel. They may change with change of position. Signs of pneumothorax, hydrothorax, and hydropneumothorax are often noted. The affected side may be prominent and its movements restricted, the subcostal angle may flare and Litten's phenomenon is often absent on that side. There is always a dextrocardia to some degree. The abdomen is often scaphoid.

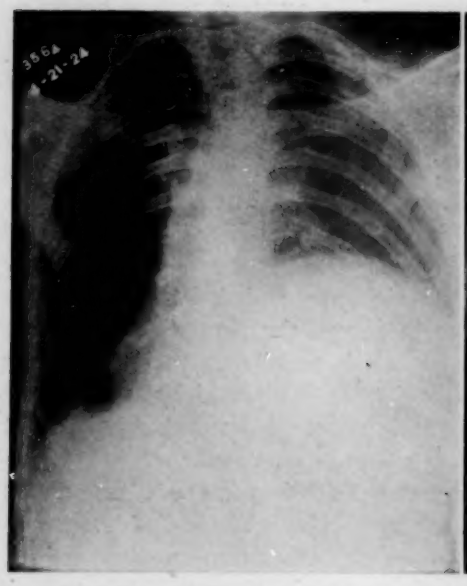

FIG. 1.—Röntgenogram of chest, showing opacity in left side of chest extending upward from abdomen.

FIG. 2.—Röntgenogram of abdomen after opaque meal, showing barium in small portion of stomach remaining in abdomen.

The literature of diaphragmatic hernia has been much enriched during the past few years by such papers as those of Giffen,[1] Harrington,[2] Stimson,[3] Truesdale.[4] The literature of the condition, however, is not so extensive but that the contribution of single observations is still of value. The report of the following case, therefore, is of interest:

CASE REPORT

A white man, aged twenty-five years, entered the Government Hospital for the Insane at Washington, D. C., on March 26, 1924, supposedly in good health although somewhat emaciated. The only events of importance in his history were that while soldiering in the Canal Zone in August, 1920, he had shot himself through the left chest with a 0.48 calibre pistol, apparently with suicidal intent, and that later he was committed to the Walter Reed Hospital for insanity. The diagnosis of the mental condition was catatonic dementia præcox. Because of the psychosis, a history of the illness which constitutes this report was unreliable. On April 17, 1924, the patient began to vomit everything immediately after eating. He complained of being chilly and of having

abdominal pain. His temperature was only slightly elevated and his pulse and respiration were normal. The vomiting after meals and the pain persisted.

Physical examination revealed considerable emaciation. There were three scars on the thorax. Two of them were about 2 centimetres in diameter; one was 2.5 centimetres below the left nipple in the fifth intercostal space, the other 4 centimetres above the right nipple in the third interspace. The third scar was somewhat larger and located 5 centimetres to the left of the spinous processes in the mid-dorsal region, tenth interspace. The chest was of the elongated flat type. Respiratory excursion was limited on the left side. Tactile and vocal fremitus were not determined because of the patient's inability to coöperate. Percussion of the chest showed no impairment of resonance on the right side. There was an area of flatness extending up to the third rib on the left side, and to a certain extent shifting in character. The percussion sounds over this area changed from time to time and on several occasions the flatness entirely disappeared and was replaced by a distinct resonant note bordering on tympany. Auscultation over this area showed an absence of breath sounds at all times. The cardiac pulsations were visible and palpable in the fourth and fifth interspaces between the right border of the sternum and the right parasternal line. The heart sounds were heard over this area and were normal. The abdomen was markedly scaphoid. Some tenderness was noted in the upper left abdomen and a few hard masses were palpable along the normal course of the colon, particularly the ascending and transverse. The physical examination otherwise was essentially negative.

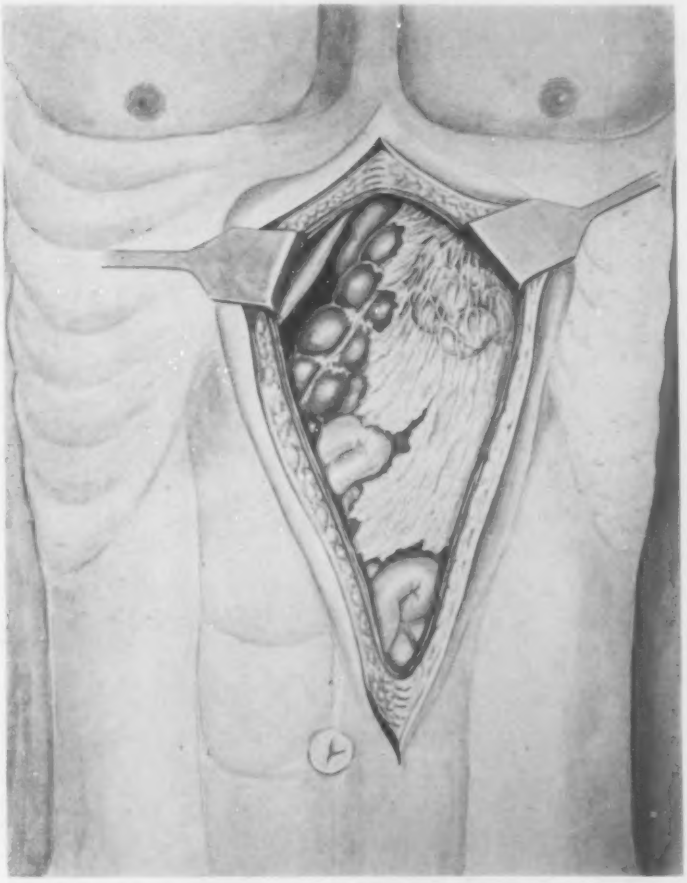

FIG. 3.—Drawing showing appearance of viscera upon opening abdomen.

The laboratory findings were unnoteworthy except for a leucocytosis of about 15,000 on several occasions. The blood Wassermann was negative. Examination of a greenish fluid obtained from paracentesis thoracis on one occasion showed blastomycetes. Examination of the fæces was negative for occult blood. The vomitus showed an absence of free hydrochloric acid, but otherwise was negative.

A röntgenogram of the chest (Fig. 1) showed a normal diaphragm on the right

side, while on the left side there was an opacity extending upward from the abdomen as high as the third interspace anteriorly, with a smooth, rounded dome above. This area presented practically the same degree of opacity as the liver area. The heart shadow was shown to be displaced to the right. After the opaque meal, which was mostly expelled immediately after ingestion, the picture showed the rounded opacity of a small amount of the meal, to the left of the vertebral column, and just below the situation of a normal diaphragm. (Fig. 2.) Apparently none of the opaque meal entered the herniated greater portion of the stomach, as the röntgenograms of the chest before and after the meal were identical. Incarcerated and obstructed diaphragmatic hernia was considered the most likely diagnosis, and the patient was given a transfusion of 600 cubic centimetres of blood and fluid by hypodermoclysis preparatory to operation.

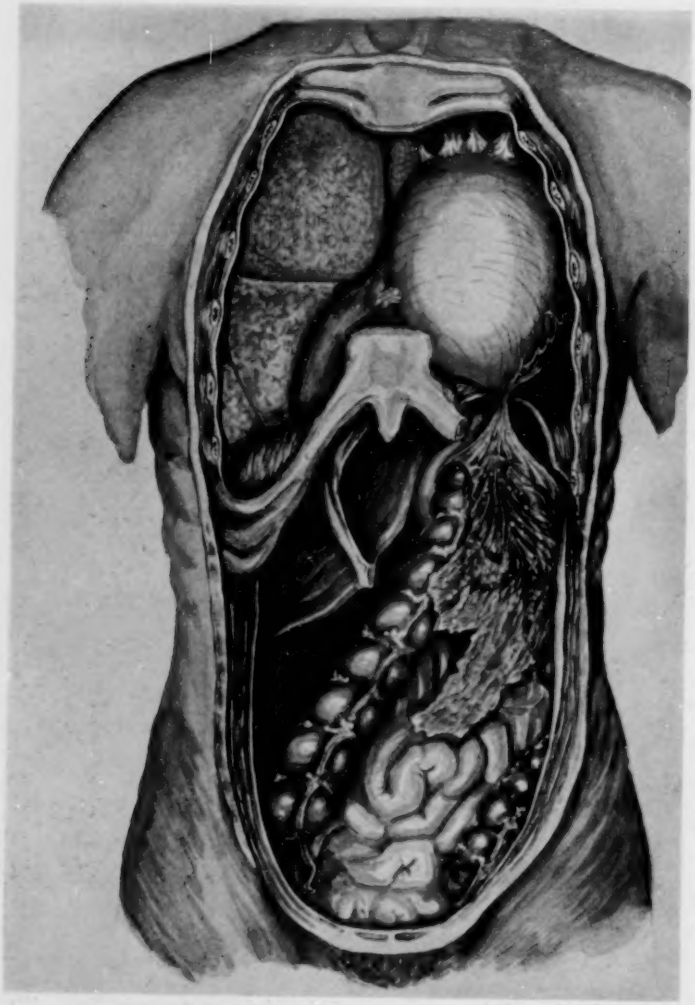

FIG. 4.—Diagrammatic drawing showing location of viscera in thorax and abdomen.

On April 30, the abdomen was opened under local anæsthesia by a high left rectus incision. The first observation made was that the transverse colon, containing hard lumps of fæcal matter, was puckered in a mass under the left dome of the diaphragm, pulling the hepatic and splenic flexure into the mass. (Fig. 3.) The ascending colon had been pulled from its normal position, assuming a new oblique course across the abdomen, from the lower right quadrant to the left dome of the diaphragm. (Fig. 1.) Assured that the whole of the small and large bowel was in the abdominal cavity, the operator made a search for the stomach, which revealed its absence from the abdominal cavity, except for a very small portion of the pylorus and the lesser curvature. The œsophageal opening in the diaphragm was normal in size and contour but had been dragged toward the left. The herniated stomach was passing through a small aperture about 4.5 centimetres to the left of the normal position

of the œsophageal foramen, with the puckered mass of colon and the omentum firmly adherent around the false opening. (Fig. 4.) Adhesions were separated on the inferior surface of the diaphragm and as far as the finger could reach on the superior surface. With all palpable adhesions freed, an unsuccessful attempt was made to return the stomach to the abdomen. The rent in the diaphragm was enlarged by a slight incision and the hand and arm passed into the thoracic cavity. Many adhesions between the stomach and the superior surface of the diaphragm and the parietal pleura and pericardium were found. The stomach apparently filled the left chest. It seemed plausible that after the stomach was freed from adhesions binding it to adjacent structures that it could be easily returned to its normal position, but this was not the case, even with considerable bimanual push and pull. The question immediately arose as to whether to evacuate the stomach with a trocar and cannula or do a thoracotomy. The former course was chosen and a voluminous amount of gas and fluid were evacuated. (Fig. 5.) The emptied stomach was then pushed into the abdomen with ease and the trocar wound quickly closed in the usual manner. The margins of the rent in the diaphragm were freshened and sutured in the usual way without difficulty. (Fig. 6.) The patient left the operating room in fair condition. Continuous Murphy drip was given, also 600 cubic centimetres of normal saline intravenously, and 500 cubic centimetres of normal saline by hypodermoclysis. The next morning the patient seemed weak, washed out, talked very little, and only occasionally moved his limbs. The pulse was of fair quality but rapid. The temperature was normal. During the afternoon he became suddenly worse and rapidly expired.

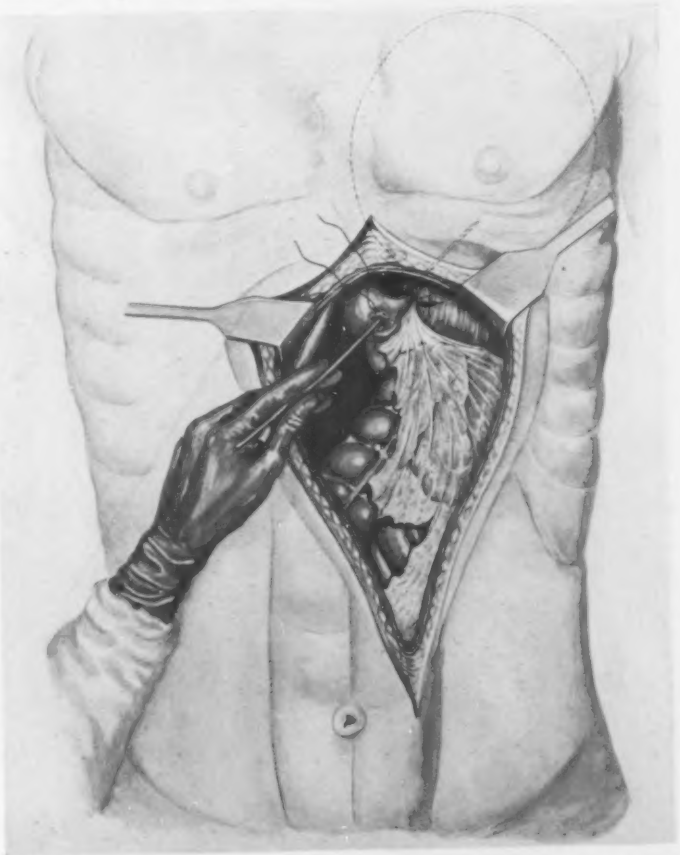

FIG. 5.—Drawing showing insertion of trocar and cannula through pyloric end of stomach to empty thoracic portion of stomach.

Necropsy revealed the left pleural cavity to be almost empty except for about four ounces of blood. The left lung was very small and lying against the spine. The whole upper lobe crepitated on pressure but only the upper portion of the lower lobe. Upon resecting the lung at the hilum about two ounces of creamy pus escaped from the bronchi. The lower four-fifths of the lower lobe of the left lung was solid, with a sharp line of demarcation. The diaphragm on the left showed a rent about 6.5 centi-

metres long which had been sutured and was apparently healing. The right extremity of the rent was about 2.5 centimetres to the left of and anterior to the œsophageal hiatus of the diaphragm and extending laterally toward the left axillary line. There was a dense fibrous band on the pleural surface of the diaphragm just to the lateral side of the rent extending laterally to the anterior axillary line. The right lung, pleural cavity and diaphragm on the right were apparently normal. The heart was small and in the midline. The abdominal viscera were all present and in their normal positions. The incision in the abdominal wall was healing. The repaired trocar wound in the pyloric end of the stomach was located with difficulty and was almost healed. The stomach appeared normal. The small intestines were empty and contained no gas. The cæcum, ascending colon, and transverse colon contained hard masses of fæcal matter, but the descending and sigmoid colon were empty. The appendix was long but normal. The liver, spleen, and kidneys appeared normal. The brain was grossly normal.

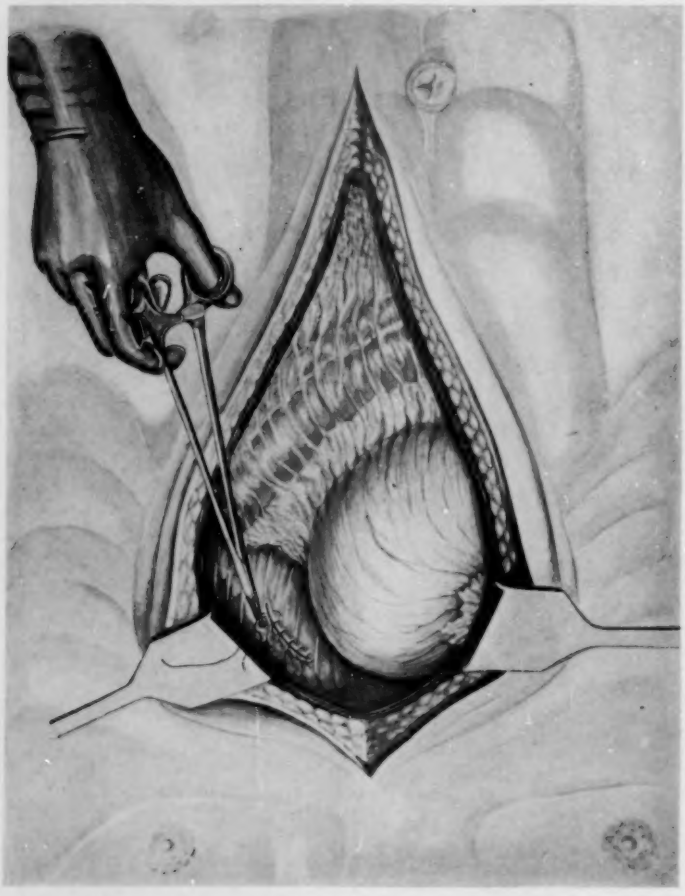

FIG. 6.—Drawing showing suturing of rent in diaphragm, with stomach replaced in abdomen.

Comment.—The manner of production of the hernia in this case is interesting. There were three scars on the chest, all resembling those resulting from the penetration of bullets. Evidently the two in the left side of the chest were the scars produced by the entrance and exit of the bullet which had injured the diaphragm. From the location of these two scars the bullet must have grazed the pericardium in the region of the apex and taken out a small piece of the diaphragm. Because of the mental condition of the patient the history of the infliction of the injury and the subsequent symptoms were unobtainable. At the time of his entrance to the Government Hospital for the Insane the emaciation was assumed to be due to refusal to eat. In the light of the condition later revealed

it was probably due to inanition resulting from partial obstruction of the stomach. Four years after the injury the obstruction suddenly became complete, and the subsequent course was rapidly downhill. The operative difficulties were not especially serious, and we feel that recovery would have followed earlier intervention. The inability of the patient to coöperate and the unusual nature of the lesion caused a longer delay than usual in cases of obstruction of the gastro-intestinal tract. The diagnostic puncture of the chest which resulted in aspiration of the contents of the herniated stomach was a dangerous procedure, but fortunately produced no harm. The appearance of greenish fluid containing blastomycetes should in itself have been sufficient to make the diagnosis of diaphragmatic hernia. This is a diagnostic procedure which we, of course, do not recommend.

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THE COMPOSITION OF THE BILE FOLLOWING THE RELIEF OF BILIARY OBSTRUCTION

REPORT OF A SERIES OF ILLUSTRATIVE CASES*

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The wide range of variation in the character of the bile, as observed in the operating room, and in the material obtained by surgical drainage of the biliary tract, is a surgical commonplace. The difference in color and consistency of the bile from the gall-bladder and that obtained from the hepatic duct, the occurrence of thick, tarry "stasis" bile in one case of obstructive jaundice and of "white" bile in another, the different prognostic significance of the finding of white bile at the time of operation, and of its appearance subsequent to the establishment of adequate biliary drainage, and many other similar phenomena have been pointed out as a result of observation in the operating room and at the surgical clinic.[2] Physiologic experimentation, stimulated by the results of surgical experience, has served to explain some of the phenomena mentioned. The work of Rous and McMaster, in particular, has served to emphasize the concentrating function of the gall-bladder, and its rôle in determining the characteristic composition of bile from the gall-bladder and of "stasis" bile, as contrasted with that of the bile secreted by the liver. These same investigators furnished final proof of the relation between the accumulation of the secretion of the mucous membrane which lines the gall-bladder and bile ducts and the appearance of white bile.

In an attempt to elucidate further some of the changes observed in the character of the bile after the establishment of biliary drainage for the relief of biliary obstruction, we made a detailed study of the volume and composition of the bile in a series of surgical cases. Full details regarding the chemical analyses have been reported elsewhere.[1] At this time we wish to present a series of illustrative cases to show the effect of biliary obstruction in man, on the composition of the bile, the normal response to the surgical relief of such obstruction, and the modification of that response as a result of various associated factors.

REPORT OF CASES

Case I.—*Chronic cholecystitis with cholelithiasis and choledocholithiasis; cholecystectomy, choledocholithotomy and choledochostomy.* A Greek, aged fifty-six years, had had typical attacks of gall-bladder colic, with transient jaundice, ten and seven years before admission. He had had a third attack six weeks before coming to the

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clinic. The urine had been dark and the stools light-colored following this last attack of colic, although jaundice never was marked.

When the patient was examined, the sclerotics were slightly icteric. The edge of the liver was felt 2 centimetres below the costal margin and was firm and sharp. There was considerable tenderness in the upper part of the abdomen. The concentration of bilirubin in the serum was 2.5 milligrams in each 100 cubic centimetres and a direct van den Bergh reaction was present. There was moderate retention of bromsulphalein, and cholecystography indicated the presence of a nonfunctioning gall-bladder.

After a period of preparation, the patient was operated on March 3, 1929. The liver apparently was in good condition. The gall-bladder was contracted on many stones, which varied in size from gravel to stones 1 to 1.5 centimetres, and was removed. The common bile duct was dilated to two to three times the normal diameter, and a stone 1 centimetre in diameter was removed from the lower end of the duct. The duodenum was normal. Biliary drainage was established by a Mayo-Robson hepaticus drain inserted in the common bile duct. Postoperative recovery was uneventful (Fig. 1).

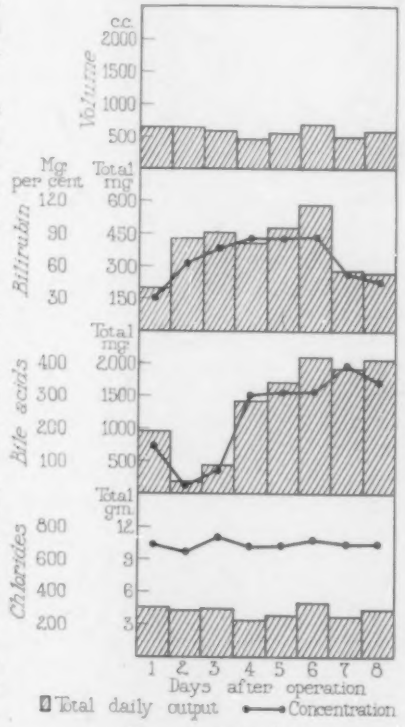

FIG. 1.—Case I.

Following the operation, there was drainage of moderate amount, 475 to 675 cubic centimetres, of bile of good color. The concentration of bilirubin increased progressively from 31 to 87 milligrams in each 100 cubic centimetres during the first week, and then was reduced slightly. Similarly, the total daily output of bile pigment increased progressively from 200 to 587 milligrams, and then fell to a level of 270 to 280 milligrams. This curve of excretion of bilirubin would suggest that there was some slight washing out of retained bile pigment during the first five or six days of biliary drainage, followed by a fall to the usual output. There was little evidence of retention of bile acids. The biliary material drained on the first day contained a considerable amount of bile acids, which suggests that there may have been some washing out of retained "stasis" bile from the biliary tract. This factor could be excluded by the second day and at that time the bile was characterized by a very low content of bile acids and a greatly diminished total output. From then on there was a rapid return toward normal. The concentration of bile acids progressively increased from 26 to 400 milligrams in each 100 cubic centimetres and the total output from 170 to 2,080 milligrams a day. The latter data much more nearly approach those found in investigations on normal dogs. The concentration of urea in the bile was approximately the same as that in the blood, whereas the total output varied from 85 to 236 milligrams, a relatively inconsiderable amount. The concentration of chlorides in the bile varied between 645 and 723 milligrams in each 100 cubic centimetres, a concentration considerably above that present in the blood serum, 553 to 613 milligrams. The total daily excretion of chlorides by this patient varied between 3.2 and 4.8 grams, a relatively inconsiderable amount, although one which might become significant if the biliary drainage were prolonged.

This case is typical of the changes in the composition of the bile as a result of partial biliary obstruction and of the return toward normal following

relief of the obstruction, as observed in a patient in whom the obstruction was neither sufficiently prolonged nor sufficiently complete seriously to affect the recuperative power of the liver. McMaster, Broun, and Rous pointed out that complete or partial obstruction of a biliary fistula in dogs produces a reduction in the volume of the bile, but that there is still greater reduction in the output of pigments, bile salts and cholesterol, so that the fluid elaborated by the liver becomes progressively poorer in the typical biliary constituents. Following the relief of obstruction, they described a copious outflow of bile which persisted until the greater part of the retained biliary constituents had been eliminated. This bile was more dilute than normal, although the increase in volume was such that the output of pigments was increased during the period of choleresis.

There is a marked similarity between the response of this patient and that reported by McMaster, Broun and Rous. The initial increase in the excretion of bilirubin in this case may be interpreted as evidence for the washing out of retained bilirubin, although it is recognized that some of the increase in bilirubin may be explained by hæmorrhage and trauma at the time of operation. The rapid increase in both the concentration and daily output of bile acids in this case speaks for the recuperative power of the liver.

CASE II.—*Chronic cholangitis and hepatitis with obstructive biliary cirrhosis; choledochostomy.* A man, aged forty-two years, had had repeated attacks of biliary colic two and a half years previously. These had occurred irregularly over a period of six months, at the end of which time he had been operated on elsewhere and the gall-bladder had been removed. In May, 1928, and again in December, 1928, he had had sharp attacks of pain in the epigastrium, followed by jaundice of three to five days' duration. A chill had preceded one attack, and pruritus, dark urine and clay-colored stools had accompanied the jaundice. The last attack had occurred two weeks before admission. The patient was slightly jaundiced. The edge of the liver was firm and extended 5 centimetres below the costal margin. The spleen was just palpable. The concentration of serum bilirubin was 2.2 milligrams in each 100 cubic centimetres and a direct van den Bergh reaction was obtained.

At operation, March 2, 1929, the liver was found to be large and bulky and presented the characteristic appearance of obstructive biliary cirrhosis. The common bile duct was dilated and was found to contain purulent-appearing bile, but no stones. A T-tube was inserted to permit of prolonged drainage. Post-operative recovery was uneventful (Fig. 2).

The volume of the bile in this case was not significantly different (120 to 425 cubic centimetres) from that observed in Case I, and the changes in the concentration and daily output of bilirubin were similar. During the later stages of the investigation the total excretion of pigment was considerably reduced, although the cause of this reduction is not evident. Individual differences between patients, a reduction in the production of bilirubin in consequence of the cholangitis and the obstructive biliary cirrhosis, and the possibilty of incomplete collection of bile through the T-tube must all be considered before a final decision is made in the matter. Both the concentration and daily output of bile acids were low at first and increased progressively as

drainage persisted. Recovery was much slower, and the quantity of bile acids excreted fell considerably below the maximal amounts observed in Case I. The changes in the concentration of urea and chlorides were similar to those observed in the preceding case.

The general course of events was the same in this case as in the preceding one. The return toward normal and the whole curve of recovery, especially as far as the output of bile acids was concerned, were slower and less complete. Our experience with dogs with a permanent biliary fistula has indicated that the development of cholangitis, with its associated cirrhotic changes in the liver, may rapidly reduce the attainable concentration of bile acids in the bile. The same would seem to be true in patients and the apparent reduction

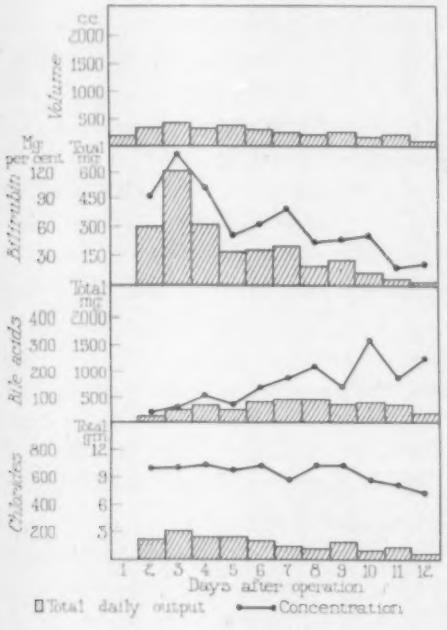

FIG. 2.—Case II.

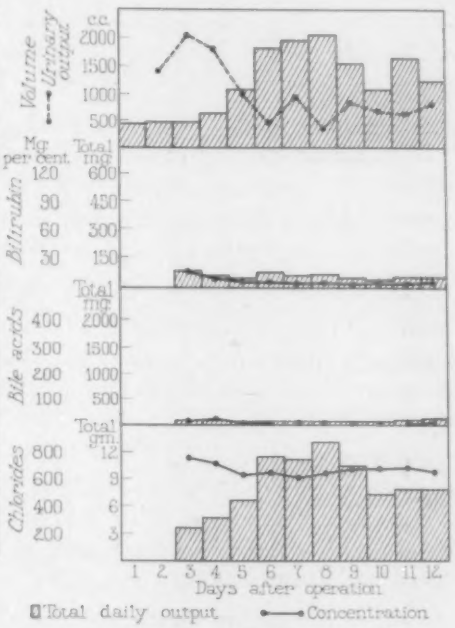

FIG. 3.—Case III.

in the recuperative power of the liver in this case is further evidence of the functional disturbance produced by the combined effects of biliary obstruction and infection.

CASE III.—*Carcinoma of the pancreas with obstructive jaundice; cholecystostomy preliminary to cholecystenterostomy.* A carpenter, aged sixty-six years, had begun to lose weight and strength and had noted failure of appetite in August, 1928. Painless jaundice, with pruritus, dark-colored urine and clay-colored stools, but without associated chills or fever, had developed in November. The jaundice persisted and the patient came to the hospital seven weeks later. At that time he was markedly jaundiced. The liver was enlarged, smooth and firm, and a distended gall-bladder was readily felt. The concentration of serum bilirubin was 24.2 milligrams in each 100 cubic centimetres and a direct van den Bergh reaction was present. Bile was not obtained by duodenal drainage.

After a course of pre-operative preparation cholecystostomy was performed January

5, 1929. The gall-bladder was found to be greatly distended in consequence of a carcinoma of the head of the pancreas. The patient's condition improved considerably after drainage, and cholecystgastrostomy was performed January 17, 1929. Thereafter the post-operative recovery was uneventful (Fig. 3).

Marked cholerrhagia developed between the fourth and sixth days after the institution of biliary drainage, and the output of bile increased from 480 to between 1,100 and 2,050 cubic centimetres. The biliary drainage was light-colored, and after the onset of the cholerrhagia became remarkably dilute. The concentration of bilirubin dropped to between 3 and 5 milligrams in each 100 cubic centimetres at a time when the concentration of bilirubin in the serum was between 13 and 14 milligrams. The urine was heavily stained with bile pigment. The daily output of bilirubin in the bile was reduced in spite of the great volume of the latter. Formation of bilirubin in this case must have been greatly reduced and credit for the final clearing up of the jaundice must be ascribed in part to the vicarious action of the kidney. The behavior of the bile acids even better illustrates the profound disturbance in the biliary function of the liver in this case for the bile was almost completely acholic and the daily output was a matter of milligrams instead of grams as in Case I.

Surgeons long have recognized the serious prognostic significance of white bile developing in the course of biliary drainage.[2] This is a case in point and the chemical changes in the composition of the bile emphasize the severity of the disturbance in the biliary functions of the liver. The concentration of urea in the bile was not changed sufficiently to be worthy of special note. As in the other cases, the concentration of chlorides in the bile was relatively fixed, and slightly greater than that in the blood serum. The development of the cholerrhagia, in consequence, resulted in an increase in the daily output of chlorides from 3.62 grams to a maximum of 13.05 grams. A mixed diet ordinarily will not contain any more salt than this, and a limited diet, such as is ordinarily given hospital patients, will contain much less.

In this case, oral administration of fluids was forced and an additional 1,000 cubic centimetres of a solution containing 100 grams of glucose and 10 grams of sodium chloride were given intravenously, so that the daily intake of fluids varied between 3,000 and 4,000 cubic centimetres. Notwithstanding this liberal intake of fluids, the output of urine following the onset of the cholerrhagia was reduced from a level of between 1,425 and 2,025 cubic centimetres to a level of between 500 and 800 cubic centimetres. Under these conditions, unless care is taken to secure an adequate intake, there is danger of serious depletion of both fluids and salt in consequence of such cholerrhagia. The significance of the development of cholerrhagia as an unfavorable event after biliary drainage has been recognized by surgeons and has been commented on by Walters and Parham. The present data furnish adequate physiologic basis for this observation.

Case IV.—*Carcinoma of the common bile duct with obstructive jaundice; choledochostomy.* A man, aged sixty-two years, had had irregular attacks of epigastric soreness and distress for two to three years. Painless jaundice had developed in August, 1928, but had cleared spontaneously after two to three weeks. A month later, the urine had become dark, and jaundice had recurred and persisted while the stools had become acholic. On examination, there was marked jaundice, and the edge of

the liver could just be felt at the costal margin. The concentration of serum bilirubin was 12.9 milligrams in each 100 centimetres, and a direct van den Bergh reaction was present.

After a period of pre-operative preparation, exploration of the biliary tract was carried out January 5, 1929. A duodenal ulcer and carcinomatous stricture of the common and hepatic ducts were found. A catheter was inserted in the intrahepatic portion of the hepatic ducts for biliary drainage. The patient did not do well following operation, signs of renal insufficiency developed on the eighth day and he died of uræmia two weeks later (Fig. 4).

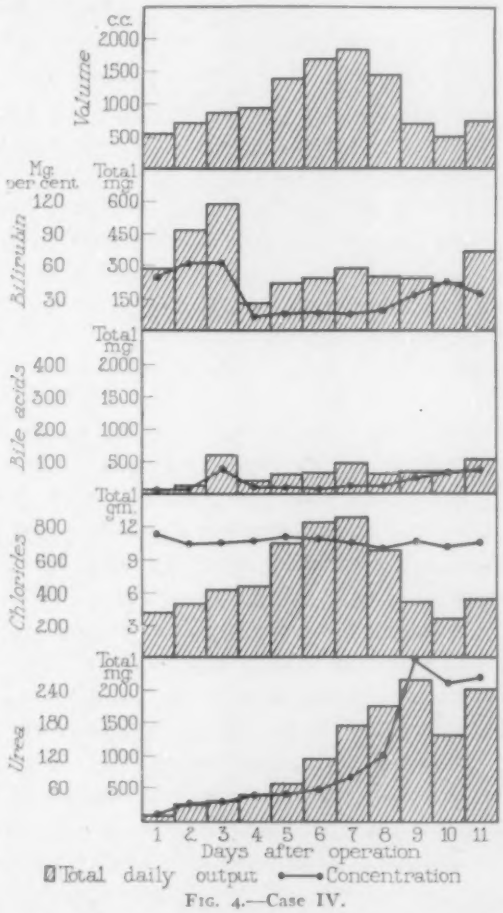

FIG. 4.—Case IV.

This case is of interest because cholerrhagia, with a quantity of biliary drainage up to 1,825 cubic centimetres daily, was present between the fifth and ninth days after operation, but ceased spontaneously. Thereafter the volume of the biliary drainage varied between 200 and 760 cubic centimetres. The bile was always of light color, although never as dilute as in Case III. The volume was increased, and in consequence the daily excretion of bilirubin compared favorably with that seen in Case I. The concentration of bile acids, on the other hand, was low, and did not increase significantly during the period of drainage. The total output of bile acids likewise remained low in spite of the cholerrhagia, but it was not so markedly reduced as in Case III. The changes in the urea were most interesting, for the concentration of urea in the bile apparently paralleled the curve of retention in the blood, increasing from 15 milligrams to a maximum of 300 milligrams. The large volume of biliary drainage consequently resulted in the excretion of considerable quantities of urea, up to 2.16 grams a day, by this pathway. Normally, the urea in the bile would rapidly be reabsorbed on the passage of the latter into the intestine. In these cases, however, the presence of the biliary fistula permitted the vicarious or extrarenal elimination of a considerable quantity of urea. The output of chlorides was high, as in Case III, again emphasizing the danger of depletion of chlorides in patients with cholerrhagia.

Care was taken to maintain an adequate intake of fluids and salt, in both

Cases III and IV, in order to avoid any serious effects from the cholerrhagia. The latter, however, cannot be ascribed to the forced administration of fluids in these particular cases, for the post-operative treatment was the same in all the cases studied. The cholerrhagia, therefore, must be looked on as evidence of hepatic injury or insufficiency.

COMMENT

It is recognized that studies such as these are open to criticism from many points of view. The majority of these criticisms are inherent in the nature of the problem to be studied and so cannot wholly be avoided. Particularly is it true that when there is complete external drainage the amount and character of the bile is not the same as when this bile enters the intestine, and the normal enterohepatic circulation is uninterrupted. The cases reported are of interest, however, in that they serve to indicate some of the responses of the liver of man to the effects of biliary obstruction and its removal, as well as some of the modifications of that response in consequence of various associated conditions.

SUMMARY

The total daily output of bilirubin seems to be more or less constant and not affected by the other factors studied in this series of cases. The concentration on the other hand varied inversely with the volume of the bile. One or two patients showed some evidence of washing out of retained pigment, but if this occurred in all it took place too slowly to show distinctly in observations of as short duration as these.

Biliary obstruction inhibits or stops the formation of bile acids. If the liver is not too greatly injured there is a relatively rapid return to normal; otherwise the return is greatly delayed. This was true both with regard to the concentration and to the total amount of bile acids.

The concentration of urea in the bile apparently varies directly with that in the blood. Ordinarily this pathway of elimination is not significant, but in one case there was considerable loss of urea through the fistula.

The concentration of chlorides in the bile is slightly greater than that in the blood serum. With cholerrhagia the resultant loss of salts becomes so great as to be of clinical significance. The loss of fluids by this channel may also be so great as to cause diminution in the output of urine.

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THE SEDIMENTATION RATE OF BLOOD AS AN INDEX OF THE HÆMORRHAGIC TENDENCY IN OBSTRUCTIVE JAUNDICE

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The tendency to bleed post-operatively, in patients with obstructive jaundice, has been recognized and dreaded for a number of years. This fact is of great practical importance because it sometimes leads directly to the patient's death. Walters [1] in 1921 reported that in a series of twenty-nine patients with obstructive jaundice, who died post-operatively, fifteen, or approximately 50 per cent. died as a result of intra-abdominal hæmorrhage. Petren, according to Zimmerman,[2] investigated the operative deaths in gall-bladder cases in the large Scandinavian clinics for twenty years, and found that hæmorrhage had caused 10 to 15 per cent. of all the operative deaths.

All cases of obstructive jaundice do not present this hæmorrhagic tendency, as some patients with a most marked degree of jaundice do not bleed post-operatively, while others with a very low grade, bleed alarmingly following operation. The determination pre-operatively, therefore, of which patients are likely to bleed is important, in order to correct, if possible, the bleeding tendency or at least to prepare for transfusion if necessary.

At the present time there are several tests which are available and used in an attempt to detect this hæmorrhagic diathesis. The coagulation time of the blood *in vitro*, determined pre-operatively, is considered one of the most reliable tests and is the one most generally used. The degree and the duration of the jaundice with the associated dehydration, and the presence of purpuric spots, are considered to be indices of this hæmorrhagic tendency by some surgeons, according to Walters.[1]

There are numerous methods available for determining blood coagulability. Cohen [9] in 1911 reported about thirty, and since then there have been several others added to this list. This multiplicity of methods alone would indicate the difficulty of determining accurately the coagulation time. The most widely used test of blood coagulability is the multiple tube one described by Lee and White [3] in 1915. The normal clotting time by this method is usually considered to be twelve minutes or under. In jaundiced patients one finds quite frequently this increased to twenty or thirty minutes, or even longer. Accordingly, many surgeons believe that a patient with obstructive jaundice who has a coagulation time over ten to fifteen minutes may bleed post-operatively. This is not always the case, however, as it is not unusual to find that such a patient with a long blood coagulation time does not bleed post-operatively, while one with a short or normal coagulation time does bleed. In addition to this, the end point for the coagulation of the blood

is difficult to read accurately, and a great many minutes' variation of this is not uncommonly found in the various tubes of the above method.

Bleeding times seldom show any great variation from normal, so they are of little value. Then also one cannot predict that a patient with a high degree of jaundice will bleed and one with a low grade of obstructive jaundice will not, as the opposite is frequently the case. The same holds true for the duration of the jaundice.

The observation of purpuric spots may indicate a bleeding tendency, but the absence of them does not mean the patient will not bleed post-operatively. On the whole these tests have proven unreliable, as it is impossible to predict with the aid of any or all of them whether or not a patient with obstructive jaundice will bleed post-operatively.

The purpose of this paper is to show that the sedimentation rate of the blood is a more reliable test for the detection of this hæmorrhagic tendency than the others now available. The rapid sedimentation rate of the red cells in obstructive jaundice was first noted while determining the coagulation time of the blood in cats with obstructive jaundice, produced by ligation and division of the common bile duct.* The rate became more rapid as the degree and duration of the jaundice increased. Because of the unreliability of available tests already noted above, it was decided to run a series of sedimentation rates on patients with obstructive jaundice simultaneous with a series of coagulation times, and to follow them while in the hospital both pre-operatively and post-operatively. My attention was first focused on several cases which bled post-operatively, and these all showed extraordinarily rapid sedimentation rates at the time they bled, despite the fact they were running no fever.

There is not a great deal in the literature concerning the sedimentation rate in obstructive jaundice. Fahraeus [4] to whom is due the recent interest in this property of the blood, reported a rapid sedimentation rate in a great many diseases, but did not include cases of obstructive jaundice. He stated, however, that Schemensky [6] in 1920 reported that the sinking speed of the red cells was increased in icterus. Rosenthal and Blowstein [7] in 1929, reported the sedimentation rate, according to Linzenmeier method, in a group of patients with various types of jaundice. They concluded that the majority of cases with jaundice showed an increased sedimentation rate and in most cases of carcinoma and cholelithiasis, with or without obstruction of the common bile duct, it was rapid. They did not consider the sedimentation time of the blood a specific diagnostic, or prognostic procedure in diseases accompanied with jaundice. Lohr [8] in 1927, also reported he found rapid sedimentation rates in cholelithiasis, with or without jaundice.

A number of procedures for determining the sedimentation rate have been described, but in general these may be divided into two main methods. In one described by Fahraeus [4] the sinking speed is measured by observing, after a definite period of time, the height of the clear plasma above the upper

* This work is to be published later.

layer of red cells, and in the other, described by Linzenmeier, it is measured by observing the time it requires the upper layer of red cells to reach a definite mark on the tube. The former is the method of choice, as it is more practical to measure the distance the red cells have settled after a definite time interval, than it is to watch for the upper layer of cells to reach a certain mark. Tubes of different calibre and length are advocated by different investigators and a number of different anti-coagulants are also recommended.

The sedimentation rates, as I have determined them, were done according to a modification of Fahraeus' method, published by Plass and Rourke,[5] except that I have used powdered sodium oxalate as the anti-coagulant, instead of heparin, which they recommend. Sodium oxalate was used as it is cheaper and more readily available, and practically as accurate. Sufficient sodium oxalate to prevent the coagulation of about seven cubic centimetres of blood was used. This was approximately fourteen milligrams, which was not enough to affect the sedimentation rate for practical purposes. The usual procedure was to withdraw about five cubic centimetres of blood, and to mix this with the sodium oxalate. The sedimentation rates were then read from these specimens, usually within an hour's time after the blood had been taken. It was thoroughly shaken before being pipetted into the tubes. Dry apparatus was used throughout, except the syringe, which was washed out with normal saline. This last step prevented hæmolysis of the red cells.

There are several advantages to this method. In the first place the tubes, which are 100 millimetres in length, provide a sufficiently high column of blood to allow an accurate estimation of the sinking velocity of the red cells at fifteen-minute intervals, over a period of an hour. Then also the hæmatocrit readings may be determined in the same tubes, following the reading of the sedimentation rates.

Readings were taken every fifteen minutes for an hour, but only the readings at the end of half an hour are represented on the accompanying charts, as these seemed to indicate more accurately the true sinking velocity of the red cells. In some cases the sinking velocity was so rapid that if the readings were taken at the end of an hour, they would not have indicated even an approximation of the true sedimentation rate. For instance, in the last two readings obtained, in Case I, the rate at the end of half an hour, and one hour, were practically identical. I have arbitrarily called a sedimentation rate below 30 millimetres in half an hour a "slow" rate, and one above this figure a "rapid" one.

Normal values with this method are considerably slower than 30 millimetres in half an hour. The rate at the end of an hour in twenty-two healthy young men varied from 2 to 11 millimetres, and in forty-five healthy young women from 5 to 32 millimetres, according to Plass and Rourke. For practical purposes, these figures hold true for the modification of their method, which I have used.

Inflammatory processes have been shown definitely to increase the sedi-

mentation rate. The rate has usually been found to be between 30 and 40 millimetres in half an hour, in most of the cases of pelvic inflammation and tuberculosis we have studied. In extreme cases of sepsis with secondary anæmia the rate has increased to 60 millimetres in half an hour.

Other factors undoubtedly enter into the production of fast rates, as all the cases I have reported with rapid rates were practically afebrile, except Case 4, Charts I and III, and Case 9, Chart II. All the cases in Chart III show extremely rapid rates, the average being 50 millimetres in half an hour.

The method used in the majority of the cases for the determination of the coagulation of the blood was the multiple tube one, described by Lee and White.[3] The blood was taken from a vein in the arm with a clean dry syringe and needle. One cubic centimetre of blood was transferred from the syringe quickly, to each of three or four small test tubes 1 by 7 centimetres. The coagulation was followed successively in each tube by tilting them separately. The clotting time was estimated from the moment of puncture, until the least agitated tube, which was usually the last one, contained a firm clot.

Post-operative hæmorrhage in patients with obstructive jaundice may occur immediately following operation—primary or early hæmorrhage—or it may first appear a week or ten days post-operatively—secondary or delayed hæmorrhage. In the former the bleeding usually occurs from the wound edges or the liver bed. It may not be very obvious at the time of operation, but the following day when the dressing is examined, a persistent ooze may

TABLE I

Cases with Post-Operative Bleeding

Case	Diagnosis	Age, sex	Duration jaundice	Degree* jaundice	Coag. time minutes	Bleed. time minutes	Sed. rates	Type of bleeding
1	Ca. of liver with obst. jaundice	60F	6 wks.	25.0	2	1½	48	Early
2	Cholelithiasis with stone in c. bile duct	49F	5 wks.	25.0	7	3	50	Early
3	Biliary sinus with stone in c. bile duct	39F	—	Ict. Ind. 17	6	—	6	Early
4	Ca. of pancreas with obst. jaundice	†66M	10 wks.	21	9	3	50	Early
5	Ca. of pancreas with obst. jaundice	75M	3–4 wks.	19.0	10	—	16	Delayed
6	Cholelithiasis with stone in c. bile duct	49F	2 wks.	16.0	10	2½	14	Delayed

* Degree of jaundice indicated in milligrams of bilirubin per 100 cubic centimeters of serum.
† Case 4 had a temperature of 99–101° F.

be apparent. In the case of secondary hæmorrhage, there may be no evidence of any bleeding until the removal of some form of drain is commenced.

Coagulation and Bleeding Times.—Pre-operative coagulation times are done routinely on all jaundice patients operated upon at this hospital. Analysis of these figures show that they are of little value in the prognosis of post-operative bleeding in obstructive jaundice. Table I gives the pre-operative coagulation times of six cases seen in the past year which bled following operation. It will be noted that in all cases the clotting values were ten minutes or below. The first four of these patients all bled immediately following operation. The last two had secondary hæmorrhage. The bleeding times of four of these patients are also included in Table I. These, like the coagulation times, are within normal limits.

A large number of cases of obstructive jaundice which are operated upon do not bleed. In Table II there are ten cases, all of which presented a very high-grade obstructive jaundice. None of these bled immediately following operation and only one had secondary hæmorrhage. The coagulation time of these ten cases varied from four to twenty-six minutes. Comparison of these values with those in Table I would indicate that the prognosis in regard to hæmorrhage in at least four of the cases, which did not bleed, was worse than in those that bled. The bleeding times recorded in Table II are essentially the same as those in Table I. In addition to this unreliability of the coagulation and bleeding times, as methods of predicting which cases will bleed post-operatively, I found that even at the time post-operative hæmorrhage was taking place there was not always much change in these same tests. Table III shows the coagulation times of some of these cases when actual bleeding was occurring. The five cases in which coagulation times were done show little change from normal; the longest was twenty minutes. In cases four, five and six the hæmorrhage was secondary, occurring seven to twelve days post-operative. In the other four it was primary.

Sedimentation Rates.—The sedimentation rate, on the other hand, has proven to be of much more value in predicting hæmorrhage in these cases. Referring again to Table I, three of the four cases which had primary bleeding showed extremely rapid rates. The third one of these, which bled immediately, had a slow sedimentation rate, 6 millimetres in half an hour, but unfortunately the determination was done thirteen days before operation. The day following operation, however, it had increased to 48 millimetres in half an hour. I think undoubtedly if another determination had been done just before the operation, the rate would have been found to have increased, as it is very unlikely that the sedimentation rate would have changed from 6 millimetres to 48 millimetres in twenty-four hours, especially in the absence of fever. The findings in this case are shown in Chart II. Cases 5 and 6 had slow rates but neither bled until about a week post-operatively. At the time bleeding was taking place both had rapid rates. Chart I shows this in detail for Case 5.

The most striking results were obtained in the cases which did not bleed.

In Table II none of the ten patients bled immediately post-operatively, and only one developed secondary hæmorrhage. The sedimentation rate was slow in all these except Case 9. This patient was running a fever from 100-101° F., due apparently to chronic pancreatitis. Turning now to the results obtained at the time of bleeding, shown in Table III, it will be seen

TABLE II

Cases with No Post-Operative Bleeding

Case	Diagnosis	Age, sex	Duration jaundice	Degree jaundice	Coag. time minutes	Bleed. time minutes	Pre-op. Sed. rates	Bleeding
1	Ca. pancreas with obst. jaundice	44M	6 wks.	12.0	8	3	29	0
2	Cholelithiasis with stone in c. bile duct	42M	1 wk.	+++	5	2½	20	0
3	Cholelithiasis with stone in c. bile duct	48F	8 wks.	6	4	2	22	0
4	Ca. of pancreas with obst. jaundice	60F	1 wk.+	19	14–25	—	3	0
5	Ca. of pancreas with obst. jaundice	47M	3 wks.	25	16–26	1½	1.5	0
6*	Ca. of pancreas with obst. jaundice	75M	3–4 wks.	19.0	10	—	16	0
7	Ca. of pancreas with obst. jaundice	46M	12 mos.	16	19	—	22	0
8	Cholelithiasis with obst. jaundice	50F	1 wk.	12	3	1½	0.5	0
9†	Chronic pancreatitis with obst. jaundice	41M	2½ wks.	18.75	16	—	56	0
10	Ca. of pancreas with obst. jaundice	53M	4 wks.	14.25	9	3	6	0

* Case 6 had delayed post-operative bleeding but at the same time a rapid rate.
† Case 9 had a temperature of 100–101° F. at this time. About 10 days post-operative a small hæmatoma was drained in the wound.

that all of these cases had very rapid rates, 40 millimetres or above in half an hour. Cases 1, 2, 3, and 4 had primary hæmorrhage, and Cases 5, 6, and 7 had secondary hæmorrhages. These patients were all practically afebrile, except Case 4.

Excluding Case 3, Table I, none of the patients with slow sedimentation rates bled immediately post-operatively, and only two had secondary hæmorrhage. Three of the four cases with rapid rates pre-operatively did

bleed immediately following operation and the fourth one did not. It is worthy of note also, that three of the four which had primary hæmorrhage received a blood transfusion immediately before operation and one of these, also, a very extensive course of $CaCl_2$ therapy, indicating that the hæmorrhage would have been more marked if these precautions had not been taken. Only one of the cases with a slow rate was transfused pre-operatively and despite this none in this group had any primary hæmorrhage. The latter case had

TABLE III

Cases at the Time of Bleeding

Case	Diagnosis	Age, sex	Duration jaundice	Degree jaundice	Coag. time minutes	Bleed. time minutes	Sed. rates	Type of bleeding
1	Cholelithiasis with stone in c. bile duct	49F	5 wks.	25.0	9	2½	40	Early
2	Ca. of liver with obst. jaundice	60F	5 wks.	25.0	—	—	56	Early, not marked
3	Biliary sinus with stone in c. bile duct	39F	—	Ict. Ind. 8	6	—	48	Early
4	Ca. of pancreas with obst. jaundice	66M	10 wks.	21	9	3	50	Early
5	Ca. of pancreas with obst. jaundice	75M	3–4 wks.	27.0	14	—	34 and 62	Delayed
6	Cholelithiasis with stone in c. bile duct	49F	2 wks.	13.0	—	—	60	Delayed
7	Cholelithiasis with stone in c. bile duct	27F	2 wks.	Ict. Ind. 40	20	—	50	Delayed

a rapid rate prior to the transfusion, but following it the sedimentation rate was very slow. This patient showed no evidence of bleeding and the sedimentation rate remained slow.

Case Reports.—The following four cases with charts are illustrative of the series of seventeen cases of obstructive jaundice studied in the past year. I have chosen two cases which had post-operative hæmorrhage and two which did not.

CASE I.—Chart I shows the findings in a man of seventy-five years who had carcinoma of the common bile duct with obstructive jaundice. On entry to this hospital he said he had noticed jaundice for one day only. That he had been jaundiced longer, there can have been little question, as his serum bilirubin on admission was 19.0 milligrams per 100 cubic centimetres of serum. He was placed on a high carbohydrate low fat diet and before operation he received two 15-cubic centimetre intravenous injections

of 5 per cent. $CaCl_2$ solution. A cholecyst-gastrostomy was performed, under spinal anæsthesia, on the sixteenth day after admission. The sedimentation rate and coagulation time done at the time of admission and the day of operation showed no change, despite an increase in the degree of jaundice. There was no abnormal bleeding at the operation. The sedimentation rate had increased on the third day post-operatively. Bleeding from the wound commenced the seventh day post-operatively. It became so alarming, transfusion was done the following day. This practically checked the bleeding. The coagulation time at the time of bleeding remained about the same as before operation. The sedimentation rate was decreased following the transfusion, which corresponded to the checking of the hæmorrhage. The effect of the transfusion was only transitory as the bleeding increased again, and coincidental with this there was a tremendous rise in the sedimentation rate. The coagulation time was also found to have increased by this time. Before death the patient was bleeding from his nose and gastro-intestinal tract, and the sedimentation rate had risen to the extremely high point of 72 millimetres in half an hour.

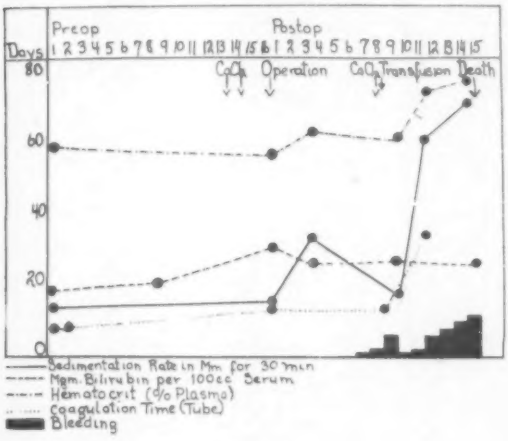

CHART I

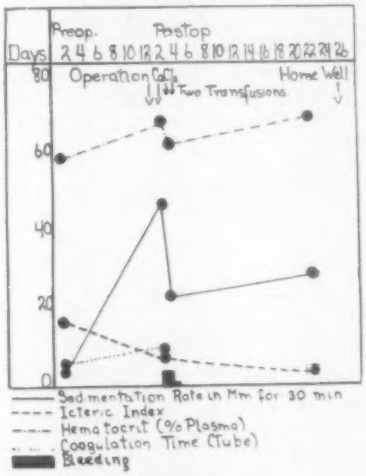

CHART II

Comment.—In this case the slow rate pre-operatively indicated that there would probably be no immediate hæmorrhage, and there was none. Post-operatively the increase in the sedimentation rate was directly proportional to the amount of bleeding. The coagulation times did not indicate this until the bleeding was very pronounced on the eleventh day post-operatively. Such an increase in the sedimentation rate post-operatively may explain the delayed bleeding in some of these cases, and also indicate the possible value of post-operative determinations.

CASE II.—Chart II represents the same data in the case of a woman of thirty-nine years who entered because of a draining biliary sinus of two months' duration, due to a stone in the common bile duct. This patient was not jaundiced clinically. The serum bilirubin was too low to be estimated quantitatively. The icterus index, however, was 17 on admission. This is about twice the normal value, but only represents a low degree of jaundice. The sedimentation rate and coagulation time were normal on admission. Laparotomy under ether anæsthesia, with removal of a stone, was done twelve days later. As already noted, if the sedimentation rate had been done, just previous to the operation, I believe it would have been found to be much more rapid than the initial determination. Thus the day following, after bleeding from the wound

had been noted, the rate was very rapid. Coincidental with this there was practically no increase in the clotting time despite the bleeding.

Following transfusion the bleeding gradually stopped and the sedimentation rate decreased from 48 to 24 millimetres. There was no more bleeding and on the twenty-second day post-operatively the rate was 29 millimetres, still relatively slow.

Comment.—Here again the sedimentation rate was high during the bleeding. When this was stopped, with the aid of transfusion, there was a corresponding drop in the rate. The coagulation time on the other hand was normal even during the time bleeding was taking place. In addition, it is interesting to note that this patient represents the type that may bleed without a high grade of jaundice, indicating it is not the bilirubin *per se* in the blood which causes the bleeding.

CASE III.—Chart III shows the findings in a man of forty-seven years with carcinoma of the head of the pancreas with obstructive jaundice who also had ascites.

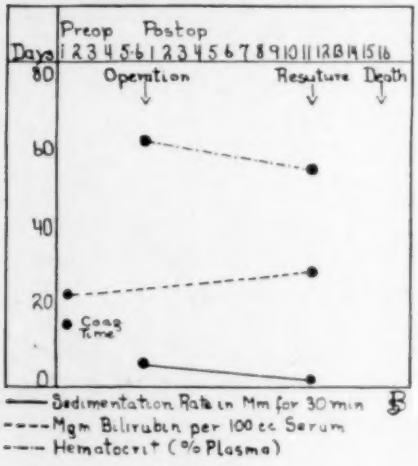

CHART III

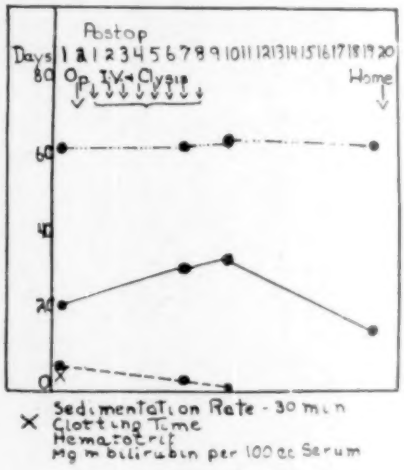

CHART IV

Pre-operative determination of the coagulation time showed slight elevation above normal, while the sedimentation rate was very slow. An exploratory laparotomy was done under spinal anæsthesia. A very extensive carcinoma with a great many metastases was found. A biopsy was obtained and the abdomen closed. The convalescence was uneventual except for a reaccumulation of the ascites, and the eleventh day post-operatively the wound broke open. Resuture of the wound was done under local anæsthesia. No abnormal bleeding occurred although it was expected, since the patient had not been relieved by the primary operation, and his jaundice had increased. The sedimentation rate taken before the resuturing was later found to be extremely slow, only 2 millimetres in half an hour. The patient died on the sixteenth day post-operatively. Necropsy revealed no evidence of hæmorrhage.

Comment.—Despite a delayed coagulation time in an intensely jaundiced man, there was no post-operative bleeding. The sedimentation rate on the other hand remained very slow, indicating that hæmorrhage, even from the secondary operation, was unlikely. In addition it should be stated that this patient received no $CaCl_2$, either by mouth or intravenously, nor transfusion in preparation for operation. At the time the wound was resutured the

bilirubin in the blood had risen to 30 milligrams per 100 cubic centimetres of serum. This is one of the highest figures I have seen. Despite this fact he did not bleed, indicating again it is not the amount of bilirubin in the blood which is the cause of the bleeding.

CASE IV.—Chart IV represents the findings in a woman of forty-eight years who entered the hospital because of jaundice of two and one-half months' duration, due to stones impacted in the common bile duct. Operation was performed under ether anæsthesia soon after entry. The pre-operative sedimentation rate was not rapid. The coagulation time was normal. No special pre-operative preparation was instituted, such as intravenous $CaCl_2$ or transfusion. The convalescence was uneventful except for early nausea and vomiting which was treated with intravenous glucose and hypodermoclysis. The sedimentation rate post-operatively did show some tendency to increase, but this was not marked. There was at no time any indication of post-operative bleeding.

Comment.—Here again, a relatively slow pre-operative sedimentation rate in the presence of a long-standing obstructive jaundice, indicated that immediate post-operative hæmorrhage would probably not occur. Also the fact it had not increased much post-operatively indicated that delayed bleeding was unlikely.

SUMMARY

The surgical treatment of severe obstructive jaundice is not unfrequently complicated by immediate or delayed post-operative hæmorrhage. It is, therefore, of great practical importance to detect before operation, which patients are likely to bleed in order to take measures to correct this bleeding tendency.

The unreliability of available tests for the detection of this bleeding tendency prior to operation, has been pointed out. Post-operative hæmorrhage was found to be in no way dependent on the degree or duration of the jaundice.

The sedimentation rate of the blood in a series of cases with obstructive jaundice is reviewed and the results correlated in reference to post-operative hæmorrhage. It is also compared with the coagulation and bleeding times of the blood in these same cases. The sedimentation rate of the blood, like the white count, is influenced by many diseases. This test is not specific nor diagnostic for any disease, but along with other data it is a valuable addition to the laboratory tests. Fevers as a rule cause a marked increase in the sedimentation rate. Because of this I wish to point out that all of the cases, with the exception of Case 4, Charts I and III, and Case 9, Chart II, in which I have reported rapid rates, have been practically afebrile. I have arbitrarily chosen a sedimentation rate of less than 30 millimetres in half an hour, according to the method used above, as a "slow" rate and one which is higher than 30 millimetres, as a "rapid" rate.

When the sedimentation rate in cases of obstructive jaundice was found immediately prior to operation to be slow, early post-operative bleeding did not occur. Furthermore, bleeding, either immediate or delayed, did not occur as long as the sedimentation rate remained slow. Three of the four

cases which had rapid rates pre-operatively bled immediately following operation despite pre-operative preparation. All patients who bled showed rapid rates at the time the bleeding was taking place.

Blood transfusion is the best known method of checking this type of post-operative hæmorrhage. Accordingly, following transfusion in these patients there was a drop in the sedimentation rate, which varied from a few millimetres in some cases to twenty or thirty millimetres in others. The bleeding always stopped when the sedimentation rate became slow.

CONCLUSIONS

1. Pre-operative and post-operative determinations of the coagulation and bleeding times are not reliable indices of the hæmorrhagic tendency in obstructive jaundice.

2. The bleeding tendency is not dependent alone on the degree nor the duration of the obstructive jaundice.

3. The sedimentation rate of the blood is a more reliable test of this hæmorrhagic tendency than the others now available.

4. Patients with obstructive jaundice who have a slow sedimentation rate are unlikely to bleed post-operatively, and those with a rapid rate in the absence of fever are apt to bleed.

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THE SURGICAL IMPORTANCE OF THE OMENTUM*

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from the research department of andrew todd mcclintock memorial foundation

In the social fabric of all organisms, from the highest to the lowest, whether animal or vegetable, whether sessile or motile—from the mammals to the corals, *protection* is all important. It ranks next in importance to reproduction itself and is much more diverse and varied in form. Its failure accounts for the obliteration of millions of species. Read what that master interpreter of life, Maeterlinck,[1] writes of protection among those lowly, ancient insects who have achieved millions of years of life as a species because of a highly specialized form of social life, the termites. Consider his interpretation of the sacrifice of the individual upon the altar of this tremendous economic urge! Well might one inquire in contemplating the individual life as compared with that of the tribe—What price safety?

There hangs in the Harvard Club of New York a stately specimen of the antlers of the Irish elk, dug recently from the peat bog which had immured the hapless creature some millions of years ago, when Ireland was still a part of the mainland. These great horns visualize to the thoughtful observer the fatal effects, upon race and individual alike, of the overemphasis or overdevelopment of any one organ. Overspecialization tends to extinction even in matters of protection! These great antlers, more than twice the size of today's moose, elk or caribou, in response to a growth-urge run riot, developed upon an animal no larger than our common deer. Not only did the yearly growth exhaust the individual's strength but these huge horns, devised especially for protection, actually came to interfere with successful quest for food to such a degree that the entire race died from starvation!

It is important to remember that by no means all structural arrangements in the human body have been benefited by signal changes in racial habit. Consider the postural habit. Man's election to assume the upright position, probably primarily protective in origin, has of course been of inestimable help in his development, yet in many details it has been far from helpful. Think of the yearnings of the gastrointestinal invalid for a return to the quadruped position—does he not instinctively sleep upon the abdomen—of the ill effects of gravity upon the female pelvis and upon the inguen of both sexes! Consider finally even so small a detail as the deficient drainage of the antrum of Highmore! How evident it is that chronic antritis accompanied by a cesspool of pus in the low lying angle, with its far-reaching sequelæ in the alimentary canal, notably diarrhœa, is directly the result

* Read before the Orange County Medical Society, Florida, February 19, 1930.

of man's upright position. Were he still a quadruped the nasal orifice would be so placed as to give perfect drainage.

In no department of human thought or endeavor is it so important to be sure of the accuracy both of premises and of evidence as in that which seeks to diagnose human ills. Thus only can one hope to arrive at the fundamental cause, at the truth. Thus only can one hope to avoid the oft-repeated but cruel error of blaming the patient for exhibiting symptoms quite beyond his control, all a part of his aberrant protective mechanism and due to physical defects unrecognized by ourselves. That this mechanism may be awry and out of bounds is nature's shortcoming, not his. Is a patient ill because he has mucus in his stools, or is this an integral and important part of nature's protective mechanism? Obviously it is the latter. What is fever, diarrhœa, constipation, vomiting, fainting—what is all pain and all disability but an expression of an ever-present protective mechanism!

As I see it, no one is in greater need of pondering upon these matters than the abdominal surgeon, for within his field there lies a generally overlooked and as yet uninterpreted organ, the omentum. In part because of its relative lack of differentiation as compared with the other abdominal viscera, its morphological variability, which is often of surprising extent, and its retention of many primitive characteristics, the function of the omentum though carefully and rather intensively studied is as yet little understood. In this respect the omentum bears some resemblance to the spleen, with the development of which it has close embryological relationship. The equally important question as to its pathogenicity, a field of great breadth and of deep interest, until recently has been given no attention whatsoever.

Poynter,[2] reviewing omental development, says that the mesogaster begins as a supporting ligament for the stomach, but through overgrowth and change of position ceases to function in that capacity and undergoes structural changes suggesting in some respects degeneration and in others specialization of function. Careful correlation between the X-ray studies of Redford K. Johnson and my own operative work supports the belief that certain interesting anomalies of the omentum are frequently so much at variance with the necessary anatomical and physiological standards as to render that structure a serious menace to health.

We have all been brought up to believe that the omentum is the most important protective structure in the abdomen, that by virtue of what has been called positive chemotaxis or facultative amœboidism it has the inherent power to migrate toward any portion of the peritoneal cavity where traumatism or infection is located. These views were derived from a period in medical history in which the deductions of speculative imagination had not yet given place to more accurate if less picturesque experimental findings.

Rubin[3] introduces the subject of his experimental researches upon the omentum by a consideration of the comparative omental anatomy in the lower forms. "The habits and stage of evolution of the animals," he says, "determine to a certain extent the development of the omentum. It is absent

in the fish. Its first indication is seen in the lowest form of vertebrates, the giant salamander. Birds have a very primitive omentum. Dogs, cats and domestic carnivorous animals have a remarkable development of this structure. The omentum in monkeys shows the nearest approach to that of man; in some it is attached to the transverse colon. Its embryological development is bound up with that of the stomach and the spleen." The chief function of the omentum appears to be to form adhesions, to engulf bodies placed in the peritoneum and which are too large to be ejected into the blood-stream, to absorb particulate solutions, and finally, to absorb via the blood-stream toxins from the peritoneal cavity. These toxins may be either endogenous or exogenous in type, that is to say, arising from damaged intestinal mucosa or from the too-abundant growth of intra-enteric bacteria.

Ewing [4] has demonstrated that the intestinal walls beneath and adjacent to omental pressure bands may become so attenuated as to consist of little save the serosa and has stated that a gut in this condition would be permeable to its contents. Rubin's studies upon the absorptive action of the omentum are therefore of great significance. Cats he found to have a relatively large omentum. It measures from two hundred and twenty-five to five hundred square centimetres. In a considerable series he resected the omenta and injected indigo carmine intraperitoneally. Blue urine appeared in from forty to sixty minutes. In the control series of cats with omenta intact it appeared in from twelve to fifteen minutes. It would appear, therefore, that the omentum is the chief absorbing agent in the peritoneum, and that its removal causes a fourfold delay in peritoneal absorption. These observations are of vital importance in connection with omentectomy as practised by us in more than two hundred human patients, serving to explain or at least to give a workable hypothesis as to the cause of the systemic and often immediate clinical improvement noted in cases of so-called chronic intestinal toxæmia. It would seem that the removal of the omentum may help to block the entry of the toxins into the circulation. Finally, Rubin concludes that the omentum has no spontaneous motility, no chemotaxis, no intelligent and spontaneous protective rôle. It cannot restore vitality nor vascular supply. The end-product of an adhesion between the omentum and any other abdominal viscus is scar tissue. It does not invariably and spontaneously repair defects in the viscera. It is useful in certain respects. "But when contrasted with the sequelæ, *intestinal obstruction, pain, etc., its beneficence is overbalanced.*"

Shipley and Cunningham [5] state that the omentum plays a very large part in the actual drainage of the peritoneal cavity. "True and pseudo solutions and granules of particulate material find their way through omental vessels to the organs of the body destined for their ultimate reception and storage, or destruction and excretion, *and the path by which they leave the omentum is not a lymphatic but a hæmic one.*" Poynter, after having referred to the experimental proof that the omentum acts differently from

other peritoneal surfaces, and that through it particulate matter and solutions are taken up from the peritoneal cavity and enter the blood-stream, makes this significant statement: "There seems to be little doubt that *bacteria and toxins are taken up in the same way* . . . the omentum is the avenue through which the peritoneal contents reach the blood stream most directly. . . . It is interesting to think that a structure so long known and so thoroughly studied should be so little understood. Radical surgery has proved that it is not indispensable to individual well being."

Warren T. Vaughan,[6] in discussing the results of an extensive study upon the reaction of the omentum, concludes that, "aside from the ability of the omentum to gather up free particles from within the peritoneal cavity, the gross and microscopic reaction to foreign germ substance does not differ essentially from such reaction in other tissues of the body, whose functions are not so clearly protective. The paucity of detail in standard reference works on the physiology and pathology of the omentum is remarkable. The omentum is an organ of no mean importance, further knowledge of which should be productive, not only to the surgeon and pathologist, but likewise to the immunologist."

John Bryant[7] has made a classical contribution to the morphology of the omentum. His discussion on "Poor Health in the Child; Some Developmental Influences and Their Importance to the Adult" is not as generally known as it later will be. While it is true that in his study he did not discriminate in the fœtus between adhesions of omental or purely peritoneal type it is probable that many of the prenatal adhesions described by him were due to embryological anomalies in the omentum. The important conclusion in his paper is that "adhesions, ptosis, and other demonstrable physical defects are of very common occurrence at all ages in both sexes, but the frequency of these defects in the adult is not markedly greater than in the child. It is not improbable that such defects may stand in a causal relation to some, at least, of the disabilities of the child and the adult." In a later paper on visceral adhesions and bands Bryant[8,9] says: "The frequency of adhesions or bands in the fetus of both sexes has been greatly underestimated. Only 5.9 per cent. were free from them. The transverse colon is more frequently involved by adhesions than any other abdominal viscus. Seven women and eight men out of every ten persons presumably have some involvement of this viscus by congenital or acquired adhesions. The distinguishing characteristics of congenital or developmental adhesions, are simplicity and lack of variety of type. The distinguishing characteristics of acquired adhesions are complexity and variety in type."

Draper and Johnson,[10] discussing their early studies on the pathogenicity of the omentum, state that, "congenital defects of the omentum may so alter its form as to destroy its protective mechanism and make it a menace to life. . . . Moreover, the fact that an immense amount of human disability is directly traceable to the pressure of omental bands accentuates the interest of the clinician in their very obscure origin and pathogenic properties." After

discussing the hereditivity of these omental deviants in the course of which they found unmistakable evidence that omental abnormalities are often handed down from ancestor to child, in accordance with the Mendelian law, they conclude, that, "omental bands may exercise angulating and injurious pressure on the colon. If present, they are bilaterally symmetrical in more than fifty per cent. of all cases. They are caused by interference with or irregularities of the developmental impulses in early embryonic life. . . . Special effort should be made in children to find and remove them before the colon has been irreparably injured."

The same writers,[11] discussing the pathogenicity of the colon, say: "True elbow deformities of the transverse colon, the majority of which are due to omental dysmorphism, usually combine in varying degree torsion and pressure . . . the end result is a physical and neuromuscular disturbance of function. Long continued pressure, leading to progressive damage to the colon wall so as to render it permeable serves to augment the inflammatory reaction in the peritoneum, and a vicious circle is thus established."

The question of pathogenicity has already of necessity been broached in the foregoing discussion of omental morphology. The very fact of the newness of this study, and also the fact that it is somewhat disquieting to find or even to seek for pathogenicity in an organ which until now has been looked upon as having only a protective rôle, excludes any dogmatic conclusions as to the character and extent of its pathogenesis. In the treatment of somewhat more than two hundred cases during the past five years, I have removed the entire omentum without immediate or late prejudice to the patient. This was done only if and when such removal seemed clearly indicated by the X-ray proof of the presence of omental deviants exerting pressure upon the bowel. The justification for such removal is the same as for the excision of any other abdominal viscus, namely, that because of disease it has become more dangerous than valuable to the individual.

From the consideration of the physiology and the morphology of the omentum, as already related, it is evident that this little understood structure is the chief factor in draining the peritoneum; that this drainage passes, not into the lymphatics, but directly into the blood-vessels; that omental excision reduces such drainage fourfold, though this may be compensated for later; that omental deviants or directional abnormalities may cause mutilating pressure upon the gut, chiefly the colon, terminal ileum and duodenum; and that through this damaged gut both endo- and exo-toxins are known to pass and to be carried largely by the omentum directly into the body cavity via the blood-stream. Is the omentum therefore as important to the human economy as heretofore generally supposed? The studies of Johnson and myself indicate not only that it is not, but also that interruption of peritoneal drainage under the condition cited and by excision of this chief drain may be of great clinical value to the gastrointestinal invalid. We have concluded that this physiological factor, this drain-block, together with the mechanical release of damaging omental pressure upon the gut, helps to

explain the enigmatic improvement so often noted in the surgical treatment of such differing disorders as epilepsy, diabetes insipidus, arthritis, dementia præcox in its early stages, neurasthenia, hay fever, asthma, non-specific skin disorders, personality changes and behavioristic abnormalities in children, and other ailments. We feel sure that the relief of the chronic constipation *as such* is of small moment compared to the other less apparent but important physiological benefits brought about by the operative procedure. For in some patients the constipation has remained essentially unchanged whereas the remote symptoms have been alleviated. If by further study our deductions are shown to be correct in trend if not in all details, it will be evident that, like fire, the omentum can be at least as potent for evil as for good, that its protective mechanism can be so highly specialized as often to do more harm than good, and that its removal will be indicated under many and for widely differing conditions. Meanwhile, the pathogenicity of this little-known structure will continue to interest increasingly all students of the pathological physiology of the abdomen.

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INTUSSUSCEPTION COMPLICATING VISCERAL (HENOCH'S) PURPURA

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The various sorts of purpura have as their common and basic sign, hæmorrhages into the skin. These hæmorrhages vary in different patients as to severity, distribution and form, and the cases observed clinically differ from one another by various other manifestations which have caused the affection to be split up into the well-known clinical types. Simple, arthritic, and intestinal purpura are described and such names as morbus maculosus (Werlhof) peliosis rheumatica (Schonlein), Henoch's purpura, purpura simplex, purpura hæmorrhagica, and purpura fulminans have been used for the different types. Some of the names obviously are given according to the organ most affected by the bleeding, which may be justified by attention being drawn to the main symptom, intestinal bleeding, bleeding into the joints, etc., but essentially this differentiation is not right as severe bleeding from one organ or another may happen in any type.

Purpura is also frequently noted as a complication of various acute infections and chronic cachexias. The idiopathic types, that is those not manifestly complicating some other primary disease, should probably be thought of as a single group even though the sub-group designations such as Schonlein's disease and morbus Werlhofii are useful as emphasizing certain symptoms and indicating the prognosis. The type known as Henoch's purpura, or intestinal purpura, or purpura with colic, is commonly a more severe and extensive type of arthritic purpura although some of these cases are without joint involvement.

Many accounts of Henoch's purpura give the impression that the pains and acute abdominal rigidity are always functional in origin and warn against operative intervention. This reaction of the abdominal muscles to bleeding in an intestine often creates the impression that we may have to deal with an acute surgical abdomen, intestinal obstruction, acute appendicitis, etc.

While it is true that many purpuras with colic do not have an actual obstructive lesion and that the intestinal rigidity finally resolves, cases exist in which operative intervention is imperative for the relief of actual intussusception. These facts have already been reported by Tonking, Lett, Barling and others and the following case further emphasizes them.

J. L., male, age thirty-one years, was admitted to Harper Hospital August 22, 1929. His previous history was of no special significance. He entered the hospital on account of pain in the abdomen which had existed for about two weeks. There was some swelling in his forearms, and the muscles of his legs seemed swollen, and red blotches appeared on his legs. Several times during the two weeks preceding his hospital entrance he had severe intestinal cramps. Four days before admission he passed fresh

blood from the bowel and vomited about one-half pint of coffee-ground material. When admitted to the hospital he had typical petechiæ on lower legs, ankles, feet, trunk and upper arms, with blood findings of severe secondary anæmia. The platelet count varied from 250,000 to 350,000 with normal bleeding time. There were red blood cells in his urine. Bowels moved intermittently, and then again he had severe constipation with intestinal pain.

To the right of the median line a long tumor mass resembling an intussusception could be palpated. Following various textbook accounts which warned against operation on the ground that visceral purpura was often taken for intussusception, the man was left undisturbed under the impression that purpura alone caused all his trouble. On August 28, however, he had such a typical attack of severe intestinal pain, as in obstruction, with visible peristaltic wave, and blood and mucus coming from his rectum, and the appearance of a tumor mass in the right abdomen that opening of the abdomen was strictly indicated. The section through a six-inch right rectus incision revealed the transverse colon very much dilated and a twelve-inch-long intussusception of the ileum into the cæcum going well beyond the hepatic flexure. The intussusception was reduced, the appendix removed and the ileum and cæcum paralleled one to the other by a few interrupted catgut sutures to prevent recurrence of the intussusception. He made a good recovery. The bleeding diminished and although rather pale, he left the hospital September 11 much improved. September 24 he had severe weakness and another attack of purpura and was re-admitted to the hospital. In spite of the usual treatment for purpura, transfusions, calcium, and parathormone, etc., he went from bad to worse, with the occurrence of hæmaturia and new intestinal symptoms. The non-protein nitrogen steadily increased, reaching 120 milligrams. He died two months after the second admission to the hospital.

The following is taken from autopsy report: "The abdomen presents no marked distention. A mass is felt on palpation in the epigastric area. On opening the abdomen, it is found to be full of fluid (sero-purulent type). A large mass of omentum is adhered to the abdominal wall in the area of previous operative scar. The spleen is about mid-line of the epigastric area, not increased in size to any considerable extent, but is markedly stained a cyanotic color due to pseudomelanosis. The stomach is of normal size, the anterior surface covered with hæmorrhagic areas. The posterior surface appears to be normal."

Intestines.—There are marked diffuse sub-peritoneal hæmorrhages of the entire gut with the exception of the splenic flexure. There are numerous smaller areas of hæmorrhage and large diffuse subperitoneal hæmorrhages causing the gut to appear gangrenous, especially in the ileum. The terminal portion of the ileum lay parallel to the cæcum. In the mid-portion of the ileum there are several perforations ranging in size from that of a fourth to a half centimetre in diameter. The peritoneum is covered with a purulent fibrinous material.

There were no significant gross or microscopical changes in the kidneys. It is likely that the increase in the nitrogen level was of intestinal origin and similar to that found in intestinal obstruction.

The liver showed round-cell infiltration and thickening of the liver capsule. There were areas of diffuse round-cell infiltration in liver lobules. Irregularity in size and staining properties of liver cells showed reaction to injury.

The cases classified under the designation, Henoch's purpura, have acute gastro-intestinal symptoms, abdominal pain, vomiting, blood and mucous stools, also hæmaturia and marked albuminuria. Curiously enough these symptoms often come on after the skin lesions have subsided or before they appear and the purpuric nature of the affection may be unsuspected. On account of the embolus or thrombosis of the mesenteric vessels, obstruction or intus-

susception is often diagnosed; but it is now well known, and the case here reported illustrates that the local thickening of the bowel wall resulting from the serohæmorrhagic œdema characteristic of intestinal purpura may lead to actual intussusception.

The mechanism is probably identical with that of the intussusception resulting from intestinal polyps or any intra-mural swelling of the bowel wall from any cause. (See Figs. 1 and 2.)

The descending fæcal column pushes the abnormal segment of bowel into the distal normal portion and produces the intussusception.

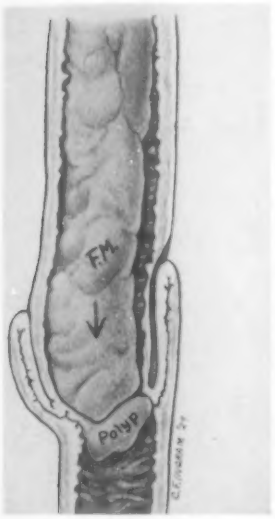

FIG. 1.—Shows how the advancing column of intestinal contents (F.M.) impinging on a polyp may cause an intussusception.

FIG. 2.—Shows the collar of thickening of bowel wall due to hæmorrhage in intestinal purpura.

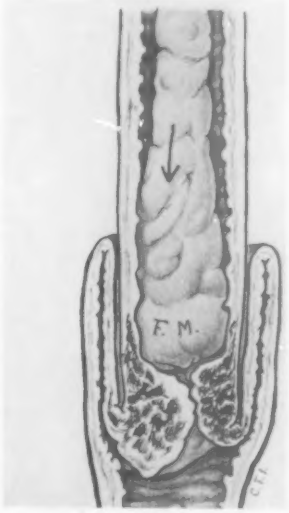

FIG. 3.—Shows how such hæmorrhage may lead to intussusception just as in the case of intestinal polyp.

CONCLUSIONS

1. Intestinal purpura may produce symptoms resembling intestinal obstruction or intussusception by causing intestinal paresis and so simulating obstruction and this obstruction may resemble intussusception by the escape of blood from the purpura through the rectum.

2. On the other hand, an actual intussusception may be caused by a thickening of the intestines caused by hæmorrhage from the purpura being invaginated into the bowel below just as intestinal polypoid tumor will cause an intussusception.

3. The presence of obstructive symptoms with intestinal purpura, therefore, requires great judgment in determining whether an actual intussusception is present or only intestinal rigidity caused by the hæmorrhages. Obviously, an intussusception requires surgical interference even in the presence of purpura, as such complication, although dangerous, is not necessarily fatal,

THE MORTALITY FROM APPENDICITIS *

By Thomas J. Ryan, M.D.

of Philadelphia, Pa.

At the 1910 session of the German Surgical Congress Kuttner stated that he had personally suffered from recurrent appendicitis for eleven years. There was a last attack in June, 1906, following which he took some castor oil; in one-half hour the pain increased and vomiting appeared together with chills and fever. Sixteen hours after taking the oil operation was performed and the appendix found gangrenous with progressive peritonitis. Conse-

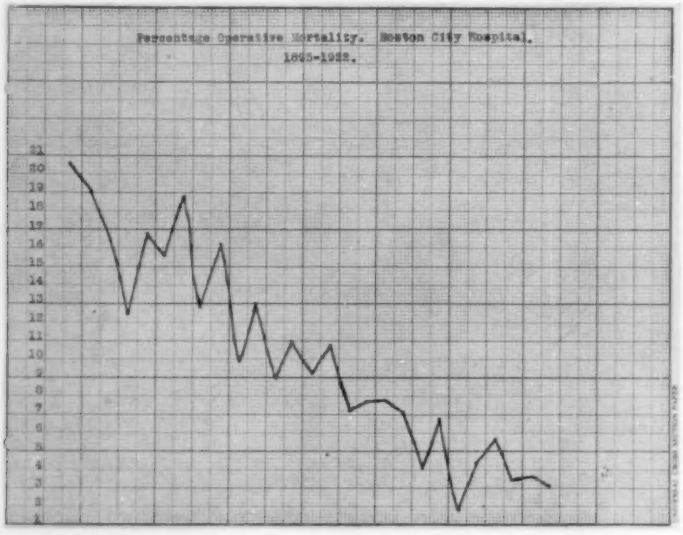

Fig. 1.—Percentage Operative Mortality, Boston City Hospital, 1895-1922.

quently he did not hold this treatment in very high favor and was of the opinion that it should be abandoned.[1] Nineteen years have passed and the subject has been taught, discussed and impressed upon us by the leaders in surgery who have seen the development of this subject to its present high standard of efficiency and who have materially assisted in the marked decrease which has occurred in the operative mortality. Dugan,[2] reporting the operative mortality at the Boston City Hospital, shows that in 1895 it was 20.7 per cent. and in 1922 it was 3.1 per cent. The number of patients operated upon in 1895 was eighty-two and in 1922 was 903. The number of patients who died in 1895 was sixteen and in 1922 was twenty-seven; showing that although the operative mortality had markedly decreased the actual number of people dying was greater.

In a personal communication from the Metropolitan Life Insurance Com-

* Read before the Philadelphia Academy of Surgery, January 7, 1930.

pany I find that their mortality in 1911 was 10.9 per cent. per 100,000 and in 1928 it was 13.7 per cent. A review of the deaths from this disease in Philadelphia shows that in 1923 there were 328 and in 1928 there were 300. The mortality in our city in 1928 was 81 per cent. higher than in 1923 in the patients between two and five years of age. Between five and ten years of age the mortality in 1928 was 47 per cent. higher than in 1923. The mortality between ten and fifteen years of age has remained the same and over fifteen years of age has decreased 18 per cent. We are, therefore, confronted with an advancing mortality between the ages of two and ten years; however, our total death rate per 100,000 is decreasing. In 1926 it was 16.4 per cent. and in 1927 it was 14.9 per cent. With the total deaths of 300 for 1928 the per-

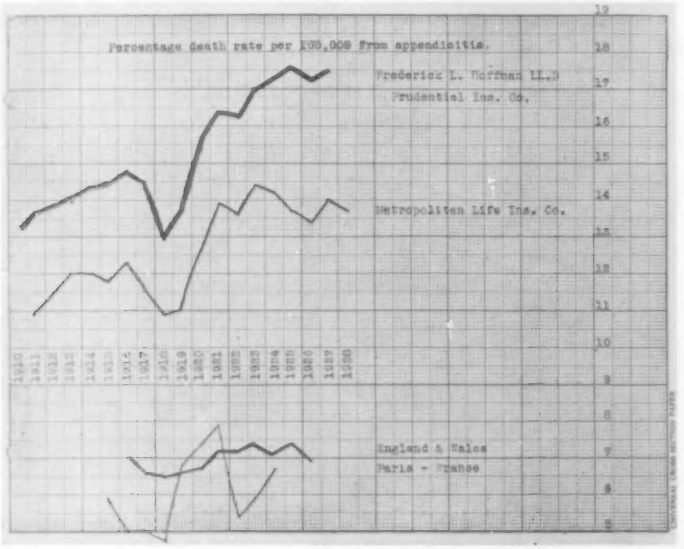

FIG. 2.—The percentage death rate per 100,000 from appendicitis, 1910-1928.

centage for this year will probably be lower than in 1927. In reviewing "The Appendicitis Record of 1927" by Frederick L. Hoffman,[3] LL.D., consulting statistician of the Prudential Insurance Company of America, I am impressed with the growing mortality from this disease throughout the United States. In a study of sixty cities the death rate per 100,000 has increased from 13.3 per cent. in 1910 to 17.6 per cent. in 1925. This increase has been consistently progressive with the exception of the years 1918 and 1919. A comparison of the year 1924 shows that our mortality was 17.3 per cent., the mortality in Paris, France, was 6.79 per cent. and the mortality in England and Wales was 7.1 per cent.

After discussing the mortality Mr. Hoffman asks the question: "Who is to blame?" and adds that it is of vital concern to life insurance companies, which in a large proportion of cases pay the claims on victims of what is obviously indicated as a failure on the part of the medical and surgical profession in the judgment of the foremost authorities on the subject. He quotes

Doctor Deaver [4] in his address before the Pittsburgh Academy of Medicine, February 28, 1928, to the effect that the important factors in the present high mortality are precipitate operation in the presence of peritonitis and not removing the appendix that has recovered from an acute attack. Dr. Charles Mayo [5] in referring to the increasing mortality is of the opinion that it is due to the fact that the younger generation of practitioners, who did not benefit by the early period of discussion, have not recognized the seriousness of such infections, and, therefore, have not made haste to diagnose and operate early in these cases. Too many operations are performed during the dangerous intermediate period between early and late infection, and possibly too much is attempted in the late operation when there is an abscess. Thus the surgeons for each period must discuss the subject and clarify it for themselves, since human experience, which affords opportunity for progress, can be passed on only to a limited extent.

It is with this thought that I am reporting this group of 100 cases of acute appendicitis admitted to my service at the Misericordia Hospital. Although I am aware that the group is small, I trust that it will show that as one of the younger generation of surgeons I am cognizant of the vast importance of this subject. The cases were consecutive admissions over a two-year period, including gangrene, abscess and diffuse peritonitis. There were four deaths. Two were from diffuse peritonitis, one from cardiac dilatation and one from hepatic abscesses. In the death from hepatic abscesses a second operation evacuated one large abscess but there were numerous small collections of pus throughout the whole liver.

In reviewing the mortality of comparable groups I find that Colp [6] reports 2841 cases operated at the Mt. Sinai Hospital, New York, with a mortality of 5.2 per cent. Wilensky,[7] reviewing this subject in Progressive Medicine, quotes Marsch with a mortality of 4.5 per cent.; Nather 4 per cent.; Hoffman 6.8 per cent.; Suermondt 7.8 per cent.; Schaer, 4.1 per cent.

Eliason and Ferguson [10] report 675 cases with a mortality of 5.3 per cent.

Muller [11] reports 101 cases with five deaths, a mortality of 4.9 per cent.

The mortality in 165 of Schaer's reported cases of appendiceal abscess was 7.8 per cent. and in seventy-two cases of diffuse peritonitis was 56.9 per cent. Ashhurst [8] reports 247 complicated cases of appendicitis with a total mortality of 13.7 per cent. In this group there were forty complicated cases.

In analyzing the symptoms of these 100 cases I find that 91 per cent. of the patients complained of pain in the right iliac fossa. Only 8 per cent. had generalized abdominal pain and one case suffered pain in the left iliac region. Although it is generally stated that the pain may be located in any portion of the abdomen we must not lose sight of the great importance of pain in the right iliac fossa which is exaggerated by pressure or coughing. In a number of instances in this group I would have made mistakes in diagnosis if I had not depended upon this early, consistent and reliable finding. The pain is the result of swelling of the mucosa and strangulation of this struc-

ture by the elastic fibres of the appendix. It occurs from three to twenty-four hours before the appearance of temperature or leucocytosis.

Leucocytosis was the next most consistent finding and occurred in 88 per cent. of the cases. Six to eight thousand was accepted as normal in this study. The importance of this finding should not be underestimated although it is corroborative and should not affect our diagnosis to too great an extent. It is the result of absorption of toxins and not necessarily an evidence of the amount of pathology to be found.

The pulse rate was increased in 87 per cent. of the cases and the temperature was above normal in 83 per cent. The pulse rate usually advances with the increase in temperature. The temperature is the result of absorption of toxins and is not an indication of the amount of the pathology. Nausea was recorded in 55 per cent. of the cases and vomiting in 46 per cent. The urine contained albumin in 47 per cent. of the cases and pus in 8 per cent. Rigidity was recorded by the interne in 60 per cent. The pathological diagnosis agreed with the clinical in 90 per cent. A McBurney incision was used in eighty cases and a right rectus in the remaining twenty. I have not been able to find any statistics with reference to the mortality which would indicate that one is superior to the other but it is my impression that the appendix can be more easily removed and drainage most effectually instituted with a McBurney incision. The application of drainage outside of the cæcum and small bowel should reduce the incidence of intestinal obstruction. No case of mechanical obstruction occurred in this group.

Nitrous oxide in combination with novocaine and ether was used in 71 per cent. of the cases; ether was used on eighteen occasions; ethylene was used once; novocaine alone in four and spinal anæsthesia was used six times. I have been using novocaine crystals dissolved in spinal fluid and have found it to be a very satisfactory anæsthetic; however, I will admit that I always use it with a certain amount of hesitancy unless I can assure myself that the advantages to the particular case will overbalance the disadvantages of the anæsthetic.

CONCLUSIONS

1. A study of the mortality from acute appendicitis in the United States shows that it is consistently increasing.

2. One hundred consecutive cases of acute appendicitis are reported with a mortality of 4 per cent. Based upon the pathological findings the mortality is 4.4 per cent.

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SUPPURATIVE RETROPERITONEAL PELVIC LYMPHADENITIS*

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of New York, N. Y.

FROM THE SURGICAL SERVICE OF DR. E. BEER, AT THE MOUNT SINAI HOSPITAL OF NEW YORK

Infection and suppuration in the glands of the retroperitoneal pelvic region due to causes other than tuberculosis are not as infrequent an occurrence as one would surmise from a review of the literature. It is rather surprising to find in a rather comprehensive study of this subject comparatively few publications during the past twenty years. On the other hand, in looking over the Mount Sinai Hospital records covering the last decade, twenty-one cases of this disease were found. The reason for its apparently rare occurrence probably lies in the fact that the symptoms are often very vague at the onset and the condition is mistaken for hip-joint disease, Pott's disease, osteomyelitis, and inflammatory diseases of the abdominal viscera (such as appendicitis) and of the pelvic organs. Its true nature is thus frequently overlooked for a time. In fact, in some of the reported cases the diagnosis was made only after the abscess had ruptured spontaneously, or as a post-mortem finding.

The retroperitoneal space lies immediately behind and outside of the peritoneal cavity, and may be divided roughly into a lumbar and a pelvic portion. When the lumbar area is involved, the symptoms are easily confused with those of perinephric and subphrenic abscess. The space itself is well supplied with a complete network of lymph channels and vessels, which extends from the diaphragm to the lowest part of the pelvic cavity. The lymph nodes of this region are divided into three groups: the mesenteric, the lumbar, and the iliac. The latter two groups are situated on both sides of the vertebral column and communicate with the lymph channels of the alimentary tract, the female pelvic organs, and the lower extremities. Here we have the explanation of the fact that infection in the retroperitoneal space generally originates in one of these sources (intestinal tract, pelvic organs, or lower extremities).

In a study of the published case reports one is impressed by the frequency with which the etiological factor remains obscure. The most common causes of retroperitoneal lymphadenitis are tuberculosis, typhoid fever, appendicitis, trauma, metastatic blood infections, and suppuration in the inguinal glands and pelvic organs, especially following labor or abortion.

In the twenty-one cases I have had the opportunity of studying the age incidence was as follows:

First decade	8 cases
Second decade	4 cases
Third decade	6 cases
Fourth decade	1 case
Fifth decade	1 case
Sixth decade	1 case

* Read before the New York Surgical Society, February 26, 1930.

The distribution as to sex was almost equal, eleven males and ten females. This is greatly at variance with published statistics, where the proportion in the female is considerably higher, according to some authors 32:4. In eighteen cases an etiological factor could be fairly definitely ascertained; in three the causal relationship was very vague and questionable. The conditions which preceded the onset of the retroperitoneal infection may be summarized as follows:

Appendicitis, 5 cases; metastatic blood infections, from furunculosis, otitis media and upper respiratory tract infections, 4 cases; distinct history of trauma on side involved, 2 cases; infections on lower extremities, 2 cases; diverticulitis, 1 case; foreign body (fish bone in colon), 1 case; gastroenteritis, 1 case; miscarriage, 1 case; diseased adnexa, 1 case. Briefly, the etiological factors were: A previous suppurative appendicitis was found to be the causative agent in five cases. In two of these the appendix had ruptured, with abscess formation; in three drainage had been instituted. In all cases except one the original appendix incision was healed and the patients had been free from fever or other symptoms for varying periods. Under such conditions it can readily be realized that the diagnosis might remain obscure for some time. The persistence of an unexplained fever following acute appendicitis, however, should make one suspicious of retroperitoneal involvement.

In four cases the infection was undoubtedly hæmatogenous in origin, following respiratory tract infections, otitis media, and furunculosis. A period of months elapsed in several cases before symptoms of retroperitoneal infection supervened.

That injury plays a definite rôle was evidenced in two instances of falling and striking the affected side followed within a few weeks by the development of retroperitoneal symptoms on this side. Very likely in these cases there was at first formation of a hæmatoma which subsequently became infected. The relationship to the other etiological factors above enumerated can readily be seen.

It is sometimes impossible to ascertain the source of the infection. This happened in three of our cases. With a history which fails to point to infection in the neighboring intraperitoneal or pelvic organs or any of the other causes above enumerated, we must classify these cases as idiopathic infections. In many instances the symptomatology is not characteristic either at the onset or during the course of the disease. Indeed, until there are definite localizing manifestations of suppuration in the iliac fossa (tenderness with mass formation) the picture may be easily confused with affections of the neighboring viscera or bony structures. The chief symptoms are the following:

Fever, at times of a low grade often extending over the course of weeks, at others intermittent with high elevations septic in type; chills and sweats of rather frequent occurrence. The presence of pain in the iliac fossa, the lower abdomen, or in the region of the groin, generally not severe in charac-

ter but more or less constant, was noted in every case. There is a gradual onset of psoas spasm, causing flexion of the thigh upon the abdomen and strongly simulating hip-joint disease. This spastic condition may be so marked that it is difficult (or even impossible) in spite of anæsthesia to straighten out the lower extremity. Increasing tenderness in the iliac fossa above Poupart's ligament, with rigidity of the abdominal muscles, develops. The appearance of a mass in the iliac region completes the clinical picture, and should make the diagnosis a certainty. It may not be manifest for weeks after the onset of the illness, but can eventually be demonstrated in almost every case, though at times the psoas spasm and rigidity of the abdominal walls make its delineation very difficult. Abdominal distention, frequently associated with the condition, may also make it difficult to palpate the mass. Rectal or vaginal examination will reveal tenderness and often induration or a swelling on the affected side of the pelvis.

Cases have been reported where suppuration had remained unrecognized until the abscess ruptured into the rectum, months after the onset. These abscesses have been known to burrow in all directions, dissecting their way through the various fascial planes and rupturing through the umbilicus, rectum or vagina, and even through the posterior abdominal wall. A leucocytosis varying from 12,000 to 20,000 white blood cells with a corresponding polymorphonuclear count is always found, but the urine shows no especially characteristic findings. Blood cultures were taken in only a few instances, and proved to be sterile, although cases have been reported in the literature with positive findings. Radiography of the pelvis and spine has in some cases been negative. In a few instances we observed haziness of the psoas outline on the affected side; and Laurell,[1] who has recently given us quite extensive and interesting observations on the radiographic symptoms of retroperitoneal suppuration reports frequent obscuration on this side. With this is associated a concavity of the spine towards the affected side, a phenomenon which had previously been described by Beer [2] and others as characteristic of perinephric suppuration. Due to spasm of the musculature on the involved side there is a thickening of the abdominal muscles in the flank, which shows up remarkably well in Laurell's röntgenograms. In addition to this, he considers as characteristic a network of dilated blood vessels in the subcutaneous tissues, due to the inhibited outflow from the veins in the abdominal wall, the result of pressure or thrombosis of the deeper veins. This is seen as a fine interlacing network of vessels on the film, in contrast to the absence of any such condition on the healthy side.

The diagnosis of retroperitoneal suppuration, as previously mentioned, may remain obscure for a long time. Cases have been reported where the condition was recognized only at autopsy. At other times the first clue as to the exact nature of the disease has been the rupturing of a large abscess through the bowel or vagina. In looking over our histories one is impressed with the slow course of some cases, which has rendered the diagnosis uncertain. A low grade temperature extending over weeks or even months,

with gradually increasing tenderness in the iliac fossa and flexion of the thigh, associated with rigidity of the abdominal wall, has in more than one instance been suggestive of Pott's disease or a hip-joint condition. Especially is this the case if the etiological factor has preceded the infection by sufficient time to lose sight of its relationship to the general picture. The diagnosis in children is more than usually difficult, especially in the absence of any apparent common cause. In the cases following puerperal infection, as reported by Huggins,[3] the differentiation of retroperitoneal suppuration from pelvic lymphangitis and thrombophlebitis may be most difficult.

Treatment, once the diagnosis has been definitely established, consists in wide incision and drainage. The importance of recognizing the true condition prior to operation is emphasized by the fact that in a few instances where such was not the case the abscess was opened into through the peritoneal cavity, with a sequence of peritonitis and death. We have in most instances employed either a para-rectus incision or one parallel to Poupart's ligament, reflecting the peritoneum mesially. At times the peritoneum has been found so fixed and indurated that this was accomplished with the utmost difficulty. The abscess cavity is then drained with soft rubber tubes (or preferably a rubber dam) and left wide open. Irrigation should not be attempted for at least one week, or until one is certain that the cavity is well walled off. Cultures of the pus have in most instances revealed the colon bacillus, streptococcus and staphylococcus aureus as the offending organisms.

The mortality rate in the definitely septic cases is by no means inconsiderable. Two patients in this series died following operation, a child ten months of age and a young woman of twenty-nine years who, following a miscarriage, developed retroperitoneal suppuration. Autopsy in this latter case disclosed, in addition, an extensive retroperitoneal cellulitis.

The following histories taken from our Service at Mount Sinai Hospital have been selected as illustrative of the condition:

Case I.—A. R., male, twenty-nine years of age, was admitted to Mount Sinai Hospital December 20, 1928. The family and past histories were negative. The present illness had begun eleven days before admission, with severe pain in the lower portion of the left chest followed by chilly sensations, temperature between 102° and 104°, and a slight cough with scanty sputum.

Physical examination on admission showed the patient flushed and slightly cyanotic, the temperature 104°. There was some dyspnœa. The heart examination was negative, the blood pressure 95/65. The lungs showed crepitant râles at both bases, and röntgenogram of the chest revealed evidences of a bronchial pneumonia. There was slight tenderness over McBurney's point, but no mass was palpable. Rectal examination showed tenderness on the right side of the pelvis. The prostate was normal. Blood count: white blood cells, 23,600; polynuclears, 82 per cent.; hæmoglobin, 98 per cent.

The sputum was negative for tubercle bacilli and cultured "pneumococcus Type IV." Urinalysis was negative, but specimens showed pneumococcus Type I in cultures. A diagnosis of bronchopneumonia was made.

This patient continued to run a febrile course with a leucocytosis. On January 1,

1929, the spleen was palpable. The chest signs gradually improved, although a soft blowing systolic murmur became apparent over the apex. By January 11 all pulmonary signs had disappeared, although the temperature still persisted around 101°.

January 12, a little over three weeks following admission, the patient complained of some pain in the right iliac fossa. There was definite tenderness, but no rigidity. Rectal examination showed a fulness above the prostate, with tenderness on the right side. A note of the possibility of a pelvic abscess was made. On the following day there was psoas spasm, as evidenced by flexion of the right thigh on the abdomen. A mass was noted in the right iliac fossa, and the rectal mass became more pronounced. At this time the blood count showed: white blood cells, 13,600; polynuclears, 84 per cent.

Operation.—January 15. Oblique incision parallel to Poupart's ligament. On separating the muscles in the axis of the fibres, inflamed glands presented, lying on a dense inflammatory layer of tissue. These were perforated, and two ounces of thick pus evacuated. Tube drainage was instituted. The cultures of pus from the abscess cavity showed streptococcus Gamma.

Convalescence was uneventful, and the patient was discharged from the hospital February 5, 1929, three weeks after operation, in good condition.

Case II.—R. G., female, twenty-seven years of age, was admitted to Mount Sinai Hospital October 3, 1925. The family history was negative. The past history included rheumatism at six years of age. Patient had been married ten years, had had two children and one miscarriage.

The present illness had begun five weeks ago, with coryza and fever lasting ten days. Four weeks previously sharp pain and soreness in the right lower quadrant of the abdomen, non-radiating in type and unassociated with vomiting, had developed and persisted. There had been several distinct chills, with a temperature of 105°. The pain, soreness and fever had continued up to the time first seen at the hospital. Patient complained of feeling weak and loss of weight. The vaginal discharge had become more profuse, thick and yellow; last period one month before admission. Patient stated that she had had a boil on the buttock incised after the onset of the present illness.

Physical examination showed a poorly nourished woman. The abdomen was soft except in the lower part, where there was some rigidity in both quadrants, with slight tenderness. Vaginal examination demonstrated a somewhat tender cystic mass about the size of an orange on the left side, more or less fixed. The right parametrium was thickened, the cervix lacerated. Smears from the cervix, vagina and urethra were negative for gonococci. The blood count showed the following: white blood cells, 11,200; polynuclears, 81 per cent.; hæmoglobin, 85 per cent. A diagnosis of right parametritis, with diseased left adnexa, was made.

October 13, ten days after admission, the white blood count rose to 14,600, and on the following day moderate pain in the right lower extremity developed.

October 25 the pain in the right lower quadrant of the abdomen became more marked, there was tenderness and resistance above Poupart's ligament; psoas spasm and flexion of the thigh on the abdomen developed.

November 1, the white blood count rose to 18,000; the hæmoglobin was still 85 per cent., as on admission.

Examination November 7 showed induration on the right side of the pelvis. There was no evidence of hip-joint disease and no spinal tenderness, although the psoas spasm was more marked and there was pronounced flexion of the thigh, attempts to extend it being very painful. The spasm could not be overcome by manipulation. A tentative diagnosis of chronic psoas spasm due to pelvic inflammation was made. On November 13 the motion of the lower spine in all directions was markedly limited and painful.

On December 7 the patient was seen in consultation by the Surgical Staff, and a diagnosis made of suppurative lymphadenitis of the retroperitoneal iliac glands, and operation advised. The urine at that time showed an occasional white blood cell; cultures were negative. The Wassermann test was negative, as were röntgenograms of the spine and pelvis.

Operation.—December 8, under gas, oxygen and ether. Under anæsthesia it was found impossible to overcome the psoas spasm and extend the thigh. Right rectus incision; peritoneum reflected mesially. An exudate was found overlying the iliac fascia. This fascia was incised, and beneath it and in between the muscles a broken-down material suggesting neoplastic tissue was evacuated. No evidence of any bony involvement could be found.

Following operation there was a profuse purulent discharge from the wound, which gradually subsided. The temperature returned to normal. The psoas spasm slowly disappeared, so that about three weeks afterward the thigh could be almost completely extended. The patient was discharged from the hospital January 21, 1926, able to walk without apparent discomfort.

The culture of pus obtained showed "streptococcus hæmolyticus." The specimen of tissue excised from the muscles overlying the ileum was reported "inflammatory exudate."

Case III.—M. P., male, four years of age, was admitted to Mount Sinai Hospital June 2, 1927. The past history was negative except for measles. Twelve days previously the boy had fallen against a chair and struck the right side of his abdomen. He then developed, just prior to admission to the hospital, pain in the right lower quadrant with temperature between 100° and 102°.

Physical examination showed a well-nourished child. A small, tender mass could be palpated mesial to the anterior-superior spine. There was no rectus rigidity. Röntgenography of the pelvis was negative, as was rectal examination. The blood count was slightly elevated. A diagnosis of appendicular abscess was made.

Operation.—Through a right rectus incision a normal rectrocæcal appendix was exposed. Along the lateral wall of the pelvis, lying extraperitoneally and to the outer side of the iliac vessels, a fluctuating mass the size of a plum was found. This was opened after the peritoneal cavity had been packed off, and the pus evacuated. The cultures were reported "streptococcus Beta."

This child made an uneventful recovery, and was discharged from the hospital July 7, 1927.

Case IV.—J. S., female, four and one-half years of age, was admitted to Mount Sinai Hospital January 9, 1928. At the time of admission this young patient had a discharging ear, for which a mastoidectomy was performed.

Three days after operation she developed pain in the right hip region, with gradual flexion of the thigh upon the abdomen and elevation of temperature. Two weeks later a mass on the right side of the pelvis, over Poupart's ligament, was noted. Radiograms of the pelvis were negative.

Operation.—The abscess was opened and drained. Cultures of the pus from the ear had been reported "streptococcus Beta"; those from the retroperitoneal abscess showed an unidentified coccus in chains.

The child's convalescence was uneventful, and she was discharged from the hospital March 8, 1928.

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OBSTETRICAL PARALYSIS*

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Ever since the original publication of Duchenne and Erb, the term "obstetrical paralysis" (Erb's palsy, Erb-Duchenne paralysis, neuritis of brachial plexus) has come to be known as that condition affecting the upper extremity, and taking place at the time of delivery. There have been other cases described involving facial muscles and muscles of the lower extremity, but these cases are rare and have lately been classified under different headings.

The history of the condition dates back to the cases of compression paralysis reported by Smellie in 1768, in which the paralysis was encountered during a delivery with face presentation. Duchenne first described the condition in a logical way in 1872, but we have evidence of obstetrical paralysis in difficult deliveries as long ago as 200 years and it is quite probable that the condition has existed since forcible delivery was first employed.

Although Duchenne recognized three distinct forms, yet the type about which he wrote at length was that involving the upper extremity and designated by him as "laceration brachial birth palsy."

Two years later (1874), Erb published a case of this type, and as a result he has received much of the credit for the description of this lesion. In Erb's original paper he named as the causative factor "pressure in the axillary space, caused by the hooked finger as practiced by The Prague Method of eversion and forcible extraction." He apparently did not appreciate the inconsistency of a permanent palsy being induced in the fifth and sixth cervical nerve root distribution by pressure in the axilla.

Etiology.—Since Erb and Duchenne published their articles, the weight of opinion has been directed toward the belief that obstetric paralysis is due to a stretching or partial tearing of the brachial plexus.

Taylor states that the condition may be caused by tension on the nerve trunks which first ruptures the nerve sheath and later tears the nerve fibres. In addition to rupturing the nerve sheath there is hæmorrhage into the nerve substance resulting in a hæmatogenous infiltration into the surrounding tissue. Following this, there is cicatrical contraction, and this in turn causes pressure upon the nerve, resulting in strangulation and preventing regeneration.

While nerve injuries may occur in all varieties of presentations, most authorities believe that the Duchenne-Erb type of palsy which involves the fifth and sixth cervical nerves is found almost exclusively after breech presentations.

T. Turner Thomas departs from the general opinion in his belief that obstetrical palsy is clearly due to some injury in the shoulder region.

* Read before the Philadelphia Academy of Surgery, January 7, 1930.

Weil, however, believes that the dislocation is to be regarded as the effect of paralysis, and not as its cause. No distortion of the shoulder joint can be demonstrated in the new bone. He believes that there is a great deal of palsy which, however, takes place *in utero*.

Sever states that the resulting paralysis is usually due either to forcible labor, a large baby, a small pelvis, anæsthesia, forceps, and generally a head delivery with the shoulder caught behind the pubis. With the last-named condition present, force applied so as to separate the head and shoulder will often result in brachial plexus injury.

The majority of cases of obstetrical paralysis occur in children of the lower classes, which means that they become cripples, and to a greater or less degree are a burden upon their parents and the community. If for no other reason than that these patients become parasitic to the community, there should be definite ideas established as to the etiology of the condition. It would seem to me that the condition can best be explained by a stretching or partial tearing of some of the branches of the brachial plexus (usually the fifth and sixth cervicals), with a secondary relaxation of the humeral capsule and the resulting deformities.

Pathology.—It is generally believed that the main pathological symptom, after paralysis has set in, is the presence of scar tissue in the vicinity of Erb's point, which is at the junction of the fifth and sixth cervical roots. In the acute form there may be a partial tearing or fraying out of some of the roots of the brachial plexus together with hæmorrhage under the sheath of the nerve which later goes on to clot formation, organization, and the formation of a cicatrix. Following this, there may be relaxation of the capsule and paralysis of certain groups of muscles. The suprascapular nerve is the one most commonly torn, and there is a fraying out at the junction of the fifth and sixth cervical nerves. There may be a fracture of the clavicle, the acromion process of the scapula, or a humeral fracture. In some cases there is a separation of the humeral epiphysis. There may be a dislocation of the shoulder, a temporary ischæmia of the nerve trunks, and, if the case is old, there may be osseous atrophy, and a shortening of the limb; there may be some stretching of the nerve fibres in milder cases, and in the more severe ones there may be actual rupture of large nerve trunks. The nerve sheaths may be injured, and there may be extravasation of blood into the sheath, or the blood may be widely spread out with subsequent inflammation.

Symptoms.—The three principal elementary deformities of a typical case of obstetric paralysis are (1) the internal rotation of the arm and forearm, (2) flexion at the elbow, and (3) the dangling of the extremity by the side. Internal rotation is impaired inasmuch as the extremity is held rotated inwardly as a part of the deformity. Passive movements with the exception of external rotation are free. In the typical position it is evident that this deformity is caused by the overaction of the unparalyzed muscles. Internal rotation of the arm is due to the action of the pectoralis major which more properly speaking adducts the arm and brings it forward over the chest.

The subscapularis rotates the arm inwardly and is assisted by the latissimus dorsi and the teres major. Pronation of the hand and forearm is partially caused by the internal rotation of the arm, but also by the inert or paralyzed supinator brevis and biceps muscles. Extension of the forearm on the arm results from a paralysis or weakness of the biceps, the brachialis anticus, the coracobrachialis and the supinator longus. In some old cases there is the inability to extend the forearm fully on the arm and is due sometimes to actual atrophy and malformation of the bones, or to a contraction of the capsule of the joint, especially the anterior portion. The reason for the extremity's hanging from the shoulder is due chiefly to the paralysis of the deltoid, and gravity keeps the extremity down.

The inability to rotate the arm externally is due to the paralysis of the infraspinatus and teres minor. The posterior portion of the deltoid helps in healthy arms to perform this movement.

The inability to supinate the forearm is due, in part, to the position of the arm and in part to weakness of the biceps and the supinator brevis.

As the paralysis continues, new conditions arise. On examination of the older cases we ordinarily find well-marked atrophy of the scapular muscles, sometimes a rotation of the scapula, or a standing off of its internal border from the ribs, which might be caused by weakness of the trapezius or of the serratus magnus. There is usually marked atrophy of the deltoid and some atrophy of the whole extremity, most apparent in the arm, somewhat in the forearm, while the intrinsic muscles of the hand are affected little or not at all.

Atrophy of the limb in the older cases is not confined solely to the muscles, but the bones themselves are affected and the whole limb may thus be smaller than the corresponding one. We may find at the shoulder a loose joint, though this is less extreme than in some cases of anterior poliomyelitis. I wish to call attention to the fact that the atrophy and paralysis of the arm muscles is less complete, as a rule, than in the old cases of anterior poliomyelitis. This may be due to the fact that in the laceration and ravelling of the nerve cords some fibres are left unharmed or are not totally destroyed.

It is quite common to find evidences of adhesions between the scapula and the structures around the shoulder joint, so that in partial passive elevation of the arm the scapula is moved, and as the arm becomes elevated above the level of the shoulder the scapula is drawn into the axilla. Inability to produce absolute extension of the forearm occurs in many cases. Passive supination of the forearm is sometimes impossible, apparently on account of adhesions.

Displacements of the head of the humerus are not rare. This usually is an anterior subluxation. It may, however, be displaced posteriorly. These displacements are due apparently to the contractions of the unparalyzed muscles and of the tissues surrounding the joint. There is no evidence of contraction of the paralyzed muscles.

The paralysis is almost always flaccid. The capsular ligament surround-

ing the joint is undoubtedly stretched. This comes as a result of complete paralysis of the spinati and deltoid muscles, leaving the posterior and external portions of the joint capsule without their usual muscular support. The glenoid cavity and the humeral head do not develop so rapidly as they should and thus favor dislocation. As the pectoralis major, which is usually only partly paralyzed, rotates the arm inwardly, it exerts fairly strong backward pressure, and this action is abetted by the subscapularis, teres major, and latissimus dorsi when these last-named muscles partially escape paralysis. The cause of the posterior subluxation is more doubtful. The paralysis of the supraspinatus is undoubtedly the most important factor. The contraction of the latissimus dorsi and the sternocostal portion of the pectoralis major tend to separate the head of the humerus from its socket, and if unopposed may cause subluxation. They are opposed by the coracobrachialis and the long head of the triceps.

Usually extension of the forearm on the arm is impaired. Full extension, either active or passive, is not possible, resistance being encountered toward the end of the extension. The forearm remains at an obtuse angle of 170 or 175 degrees with the arm. This may often be due to the contraction of ligaments or of the tissues surrounding the joints, but is at times due to atrophy and malformations of the bones themselves.

In the Duchenne-Erb or upper-arm type, the upper part of the plexus is affected. Damage involves the fifth and sixth cervical roots and there is a loss of power in the muscles about the scapula and arm.

Involvement of the eighth cervical and first thoracic results in a type of paralysis usually known as Klumpke's or forearm type. Loss of function and power occurs in the muscles of the hand and of the large flexor muscles of the forearm. The second thoracic root is sometimes involved, resulting in a paralysis of the muscles supplied by the musculospiral nerve which includes the extensors of the hand and fingers.

When there is more or less complete damage of the plexus, there is a resulting loss of power in both the arm and forearm. It is possible for this condition to be caused by a posterior subluxation of the humeral head.

In certain other cases there may be combinations of the several forms with a partial or total paralysis. In isolated cases, one muscle, such as the deltoid or supinator longus, may alone be involved. Damage involving both upper extremities is extremely rare.

When cases are seen early by the physician and if the paralyses are in conjunction with some fracture of the shoulder girdle, there is often sensitiveness to pressure and evident pain on motion of the arm. When the cases are seen during the latter part of the first year of their duration we have accommodation of contraction of muscles and a limitation of motion. In cases seen late, there is often fixed inward rotation with a subluxation of the humeral head.

The X-ray findings, as a rule, run fairly true to form. During the first year there is very little, if any, bone deformity. Following this period the

epiphysis as well as the shaft of the humerus is smaller than the unaffected side. This in all probability is caused by disuse atrophy. The scapula is practically always elevated. As time goes on there is an increased amount of subluxation of the shoulder-joint and there is a developing deformity of the acromion process which consists of a hooking down of its outer end, due, no doubt, to the fact that there is no resistance in the form of a humeral head. Scoliosis may be present and when there have been fractures there will be X-ray evidence of this. The clavicle is usually shorter and its curves more acute than normally.

Diagnosis.—Diagnosis is not difficult if the patient has been seen early. There is usually a history of a long, difficult labor, with a disproportion between the child and the birth outlet. There is usually some instrumentation or forceful manipulation in an attempt to extract the baby. After the birth of the child, manipulation of the shoulder usually causes the child to cry out with pain, the extremity hangs limp at the side, and soon becomes internally rotated. Paralysis is of the flaccid type and there is a diminution of reaction to electrical stimulation.

Differential Diagnosis.—A. A patient with obstetric paralysis seen late in the disease after he is over a year old may be readily confounded with a similar condition existing after poliomyelitis. Both diseases have atrophic paralysis of a flaccid type. The history of the case, however, will lead to a correct diagnosis, inasmuch as the age of onset is different, and the degree of wasting and the characteristic localization of the involvement readily distinguish a case of obstetric palsy.

B. We must also distinguish this condition from a spastic cerebral palsy and in very young infants this is extremely difficult. In a spastic case the attitude of the arm is the same as in the upper-arm type of obstetric palsy because the adductors and inward rotators of the humerus and the pronators of the forearm are naturally the stronger. The diagnosis may be arrived at if there is spasticity and lack of voluntary use of the lower extremity on the same side as the arm palsy unless the cerebral palsy has involved the arm only, which is extremely rare.

C. We must determine whether or not there has been a congenital luxation or subluxation or injury to the capsule of the shoulder during birth.

D. There may be present a traumatic effusion which in turn may cause a luxation or subluxation of the shoulder-joint.

E. Separation of the epiphysis may be diagnosed by X-ray.

Prophylaxis.—Prophylaxis must of necessity consist of periodic warnings to the profession emphasizing the difficulties with which we must cope and for which we must be constantly alert. True enough, in long, hard labors we are sometimes only too glad to be able to deliver the child and to save the mother, and practically any manipulation that will bring about this end is justifiable. We should try to avoid the pulling, stretching, and tearing of the nerve roots, namely the fifth and sixth cervicals which are most

likely to be put on tension by these obstetrical maneuvers, so that we can at least be making a constructive effort to avoid the production of this deformity.

Prognosis.—The prognosis varies in direct ratio to the time the disease has been going on, and to the extent of the involvement. In the more extensive cases the prognosis is extremely grave. If the nerves have simply been stretched or frayed out a little, complete or nearly complete repair and restoration of function is usually possible. If the nerve trunks, however, have been much frayed out or ruptured, and hæmorrhage has occurred between the ends, there will be retraction of the nerve fibres and formation of much cicatricial tissue. In these cases there is retardation of growth together with shortening of the tissues and very little, if any, return of function. Complete spontaneous recovery is rare and occurs only in very mild cases. If recovery is to be complete, it usually occurs at the end of three months, and almost never later than six months. In the great majority of cases there will be some permanent defect. Unless these cases are treated intelligently and early we must expect discouraging results.

Treatment.—As to treatment, the upper-arm type can, if seen early, be treated with support, massage and exercises. Those of the lower-arm type usually come to operation, which is usually a repair to the plexus. If the upper-arm type comes late for treatment, one has also to operate and correct contraction deformities. Even in the lower-arm type one may try conservative treatment and if there is no benefit one may then resort to operation. In order to prevent contraction of the paralyzed muscles, it seems best to put the arm at rest in such a position that the stronger muscles cannot contract. This may be done by means of a plaster case or a wire splint. The arm should be abducted to a right angle with the torso (90 degrees) or perhaps a little elevated so as to approximate the injured nerve. The limb should be rotated outward 90 degrees and the forearm supinated with the elbow flexed. Where subluxation or fracture exists it should be reduced. If contractions at the shoulder exist one may first try manipulation under anæsthesia.

The so-called standard treatment of Sever has been used with success for some time and on the whole is a very satisfactory procedure.

The treatment of these cases then resolves itself into those which lend themselves to massage, exercise and manipulation, usually of the upper-arm type, and those coming to operation. Unless the upper-arm type comes to early treatment it may also come to operation.

There has been no case yet, reported to my knowledge, which has shown an anatomic and physiologic cure from the plexus operation. Even marked improvement is usually lacking. This may in part be due to the fact that the deformities were not first recognized and corrected and the plexus operation done later. Many times the nerve is so badly damaged that it is beyond repair.

In a small series of cases I have employed a simple osteotomy of the humerus to correct the inward rotation at the shoulder. The operation is

done as follows: With the patient lying on his back on the operating table and the arm across his chest, an incision is made down the anterior aspect of the arm in its lower third. This incision is made so as to get sufficient exposure. Routine intermuscular dissection is done down to the bone. The periosteum is carefully dissected back and preserved. By means of an osteotome the humerus is completely cut through. Great care must be exercised in this procedure so as not to displace the relationship of the fragments. The arm is then gently rotated for 30 degrees outwardly and after routine closure a plaster-of-Paris spica case applied to the shoulder and extremity, holding the arm in the position of abduction, external rotation, and supination of the flexed forearm. This case is allowed to remain on until there is firm union, after which it is removed and a wire splint substituted, and massage and exercise begun. Exercise should be kept up for a year after operation and longer if benefit is still being derived. The results of the operation are a normal carrying angle of the arm with the elbow at the side and a normal position of the hand. It is possible to bring the hand to the head and even back of the head. It is possible to bring the hand back of the waist and in many cases, it is difficult to tell which is the operated side.

CONCLUSIONS

1. Obstetrical paralysis should be treated as an orthopædic condition and all deformities carefully observed and prevented.

2. The shoulder should be put in plaster at once, holding it in 90 degrees' abduction, 90 degrees' external rotation and with the forearm flexed and supinated.

3. In most cases the injuries to the nerves are not severe and if treated early will tend to recover.

4. Relaxation and dislocation of the shoulder are secondary lesions.

5. When the deformity of internal rotation and hyperextension of the elbow exists a rotation osteotomy is advisable and usually suffices to give function.

6. A patient suffering from obstetrical paralysis should be under observation until the age of ten for fear of a persistence of slight deformity.

OPERATIVE TREATMENT OF COMPRESSION FRACTURES OF THE CALCANEUS

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The prognosis of os calcis fractures is very bad as patients are not able to walk without pain for a long time. This is owing to the fact that, contrary to the general principles of the treatment of fractures, reduction in this type of fractures is not effected. The current methods of treatment aim only at the correction of the deformity of the heel and wholly neglect the subastragaloid joint. We must remember that in these fractures the so-called "thalamus" * is crushed into the spongiosa of the calcaneus and, what is still worse, its anterior border is pushed downward, so that the foot is twisted toward a valgus position. The equilibrium of the subastragaloid joint is disturbed; the traumatic arthritis which develops is the main cause of persisting pain and disability; as a matter of fact patients are not able to walk with comfort before subastragaloid ankylosis has set in.

It is therefore necessary in order to better the prognosis of these fractures to exercise a direct action on the depressed and tilted thalamus, to reëstablish its normal articular relations with the talus and make this permanent by fixation. In doing this, we only follow in a particular case the general rules regulating the treatment of joint fractures in the lower extremity. According to Professeur Leriche, by surgical treatment only can this be realized.

Professeur Leriche was the first (1921) to apply this method [1] which has grown to be quite a routine operation in his clinic.

The following case reports will show the results obtained.

Case I.—A., Jean, forty-two years old, a trade man, jumped out of a window from the first story of his burning house March 3, 1925. He fell standing on his feet and immediately felt an acute pain in his right heel. After examination at the clinic we diagnosed a compression fracture of the calcaneus. At X-ray picture (Fig. 1) the thalamus was slightly forced in; three principal cracks were found that presented a Y-shape, isolating partially the tuber calcanei and the greater process. Antero-posterior view showed prominent multiple fragments under the malleolus externus.

This patient was subjected to operation March 5, 1925, by Professeur Leriche under spinal analgesia. External submalleolar incision. After section of the lateral peronei tendons the focus was discovered. A big fragment divided by a Y-shaped crack was separated from the rest of the bone. It represented the biggest part of the external face and also the posterior portion of the posterior articular surface of the calcaneus. After cleaning of the focus and extirpation of multiple small spongy fragments the principal fragments were put back in place. The articular edge was reconstituted and the whole

* We call "thalamus" the thickest portion of the superior calcaneal cortex supporting the facies articularis posterior.

fixed with an "agrafe de Dujarier." Tendons and skin were stitched. The limb was immobilized in a gutter case.

The post-operative course was normal. The case was taken off April 17, 1925. Patient was allowed to go home, but not to walk.

Four weeks later he could walk with two sticks; he was still suffering a little and could not entirely put his weight on his heel. He was still carrying a very small fistula. Then a new X-ray picture showed a slight osteoporosis of the calcaneus; the fracture lines were not seen any longer. The "Dujarier agrafe" was still at the same place, but there existed around its points small areas of decalcification.

May 20 it was removed under local anæsthesia. Five months after the accident the patient could walk without any pain. When walking on uneven ground he still felt some functional disturbances and slight pain. At night there was some swelling of the foot. The fistula persisted at the level of the scar. The subastragaloid joint was already blocked.

June, 1926, the patient was examined again. A little fistula was still present. The patient could walk and work just as before his accident. A new X-ray picture showed that the calcaneus was lessened in height, but had a distinct trabecular system. The posterior subastragaloid joint was ankylosed; a few osteophytes could be seen behind it. A little sequestrum contained in a small cavity marked the place of the removed clip. As he was feeling quite well, the patient did not agree to further operation. The slight swelling had disappeared and there was no muscular atrophy.

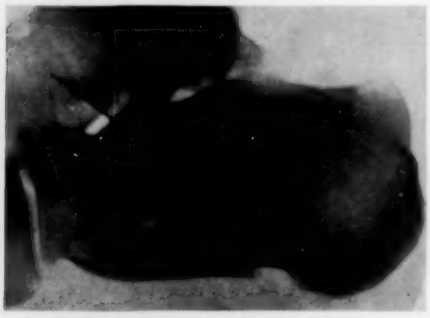

FIG. 1.—Case I. A., March 4, 1925.

October, 1926, at the patient's request, the little sequestrum was removed. January, 1927, patient was walking without any discomfort. He received no compensation fee. Footprints showed no heel enlargement and no flat foot.

CASE II.—W., Anna, eighteen years old, factory hand, on account of a fire, March 3, 1925, jumped into the street from the first story of her house. She fell on her feet, got up, but could not walk, perceiving an acute pain in her right foot which swelled up immediately. The patient was brought to the clinic. Examination revealed a large hæmatoma deforming the region of the heel. Movements were impossible. The X-ray picture showed a compression fracture of the calcaneus (Fig. 2). Lateral view showed multiple fracture lines, and among them there was one which reached the calcaneo-cuboidal joint. The tuber calcanei was almost separated from the corpus by a vertical incomplete crack. Front view showed multiple fragments under the fibular malleolus.

Two days later, on the fifth of March, the patient was operated on by Doctor Stulz under spinal analgesia. The surgeon reached the calcaneus by an external submalleolar incision. The tendons of the peronei were cut. Multiple fragments were found coming from the external compacta. One of them, found in front, bigger than the others, included the external portion of the calcaneo-cuboidal articular surface. Another, upper one, included the outer half of the posterior astragalo-calcaneal articular surface. In short the calcaneus seemed to be divided into three parts by a Y-shaped fracture line. The inner half of the posterior articular surface was still in contact with the talus and penetrated with the latter into the spongiosa of the os calcis. The crushed fragment was raised and the divided articular surface was reconstituted and screwed. An "agrafe de Dujarier" kept together the two portions of the greater process. This agrafe could not be firmly fixed in the spongious tissue. The tendons and skin were stitched and a gutter plaster case applied.

April 3, 1925: After a normal post-operative course the first case was taken off. The wound had healed per primam. A new case was put on.

April 30: The second case was removed. The foot seemed normal without broadening in its osterior part. Mobilization and massage were prescribed.

May 15: The patient got up. She could put her weight on her left foot without feeling any pain. The tibiotarsal joint very quickly recovered all its movements. The subastragaloid joint was slightly stiffened and painful on motion.

June 11: The patient could walk, go up and down stairs easily. Still there was a little muscular atrophy in the left leg and thigh. No more swelling at night. The foot presented a normal aspect. The patient could go back home with an ordinary foot pad in her left shoe. In December, 1925, we heard from the patient that she could walk without any trouble. In November, 1926, the patient was working in Paris as a chambermaid. Skiagraphs now taken showed an almost complete disappearance of the subastragaloid interline (Fig. 3). We could hardly guess the fracture lines. Trabecular system of the calcaneus was found nearly normal both in constitution and direction. The screw was well tolerated, there was no important rarefaction around it. The calcaneus was not broadened. Since then we have not heard of her.

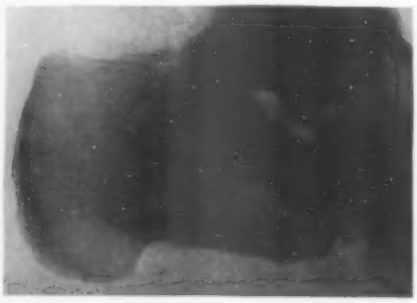

FIG. 2.—Case II. W., March 5, 1925.

FIG. 3.—Case II. W., November, 1926.

CASE III.—Z., André, fifty-four years old, clerk, December 30, 1926, fell down an elevator shaft from a height of 4 metres. He fell on his heels and felt immediately an acute pain in his right foot which began to swell. He was taken to the surgical clinic where the diagnosis of crushing fracture of the calcaneus was made. The X-ray picture showed a penetration of the thalamus with fracture of the greater process. A fracture line, shaped like a horizontal Y, divided the latter into two parts: an upper one retaining its normal position; the lower one was lightly tilted back and downward in such a way that its posterior portion was pushed toward the sole. Was immobilized in a plaster case.

January 11, 1927, Professeur Leriche operated under spinal analgesia. External submalleolar incision, section of lateral peronei tendons. Exposure of the calcaneus. The thalamus supporting the astragalus was found penetrating into the body of the bone. The thalamus is lifted and fixed in normal position to the calcaneus and the astragalus by two "agrafes de Dujarier." Articular surfaces were not abrased. A gauze drain was left in the anterior part of the wound on account of blood leaking from the everted spongy tissue. Gutter plaster case. Normal post-operative course. January 31: Dressing; new case applied.

February 15: The case and drain were taken off. Dressing. X-ray. The patient was allowed to practise foot movements.

He got up on March 2 and walked without pain. The foot was flat and in light valgus (so was the other foot, but in a lesser degree). Subastragaloid joint was blocked, tibiotarsal limited but painless. Large œdema at night. Nothing special in the scar. No muscular atrophy of the thigh.

March 28, 1927, under spinal analgesia both agrafes were removed. Astragalus and calcaneus were united and made but one bone.

April 15, patient left with his wound completely healed. He was still helping himself along with a stick but could lean on his foot without pain in spite of his weight (98 kilos'.). The œdema after standing had become less pronounced.

August 8, 1927, greatly improved; he had gone back to work June 27 and was receiving half pay. He could walk without a stick, but was limping lightly, avoiding leaning too hardly on his injured foot. At the end of a day's work he still felt pain in the back part of the foot which was in valgus. At night he had œdema up to the middle of his calf. The subastragaloid joint was blocked, tibiotarsal was free. Incapacity rate yet 50 per cent.

Patient reported November 25, 1927. He was working regularly and receiving his former salary. He was still feeling a few pains in the back of the foot, and the scar. His limp had disappeared. Œdema had much lessened. The retromalleolar gutters were still filled. Pressure revealed a tender area on the scar level under the external malleolus. Incapacity was rated at 10 per cent.

Case IV.—J., August, forty-four years old, farmer, July 9, 1927, fell down a stair. He struck the floor on his heels and at once complained of an acute pain in the back of the left foot. Unable to stand up, he was carried to the clinic, where a compression fracture of the calcaneus was diagnosed. X-ray picture showed a depression of the thalamus with a fissure slanting down and backward and ending before the calcaneal spur.

After a few days' rest he was operated on by Professeur Leriche July 16, 1927. Exposure of the calcaneus by the same procedure as before. The lesions of the external portion of the calcaneus were much more considerable than the X-rays had revealed. There were three fragments, one being almost entirely free and aiming at the astragalo-calcaneal interline. They were fixed with two screws, and an "agrafe," inserted in the calcaneus and in the external malleolus, kept the external fragment in its normal place. Sutures and plaster gutter case.

Normal post-operative course. Case was taken off August 28. After fifteen days' rest in bed, the patient was allowed to get up and walk with a small tube case, after which he walked without pain. October 18 case was removed and so were, a few days later, clip and screws.

After healing, the patient got up again. He walked easily with a stick, feeling only very slight pain in the back of the foot under the external malleolus. There was a light valgus of the foot and a noticeable œdema reaching the middle of the leg. The subastragalar joint movements were blocked; those of the tibiotarsal were reduced to two-thirds of the normal excursion. X-ray showed a complete fusion of astragalus and calcaneus in the subastragalar interline.

We have heard lately that this man was examined November 9 by an expert in order to determine his incapacity rate. The patient could walk easily, without limping. The retromalleolar gutters were still filled. Tibiotarsal joint was nearly normal, but subastragalar joint was ankylosed. The expert estimated to 20 per cent. the incapacity rate and advised a new examination nine or ten months later.

Case V.—F., Charles, forty-three years, mason, November 24, 1928, fell down from a three-metre-high ladder. Fracture of the left calcaneus resulted. X-ray showed a depression of the thalamus with a bursting of the external calcanean cortex.

Doctor Simon, November 25, under spinal analgesia, made a curvilineal incision behind and under the external malleolus. After section of the peroneal tendons he exposed the focus. The external cortex was split into many fragments. The bone tissue was completely crushed, the thalamus, forced into the spongy tissue, was tilted in such a way that its articular surface was in direct connection with the greater process. Once lifted, it could be kept in correct position only by an "agrafe de Dujarier" fixed in the thalamus

and in the greater process. Sutures of tendons and teguments. Posterior plaster splint.

Normal post-operative course. A month later the case and the stitches were taken off. The patient was kept in bed, although he was allowed to start mobilization of the foot joints. An X-ray taken December 31, 1928, showed perfect reconstitution of the articular thalamus surface. No osteoporosis at the clip level.

January 30, 1929, under local, the "agrafe" was removed and the patient allowed to get up after complete healing of the wound. Since then, he was able to walk without pain with a stick. He left the clinic February 15.

Reported March 9: he was walking easily, but yet with a stick and complaining of little pain in his heel after a lengthened walk. The foot was in good position without valgus. No œdema; only a slight thickening at the level of the external retromalleolar region. Nothing particular about the scar; the calcaneus was a little broadened and tender at pressure. Movements of the subastragalar joint were blocked. One month later the patient went back to work.

Case VI.—Mr. O. fractured his right calcaneus November 17, 1929, by falling down a stair. An X-ray showed a tilted thalamus with a fracture of the greater process and a planter fragment. He was operated on by Doctor Stulz November 18. Technic as

Fig. 4.—Case VI. Mr. O. before operation.

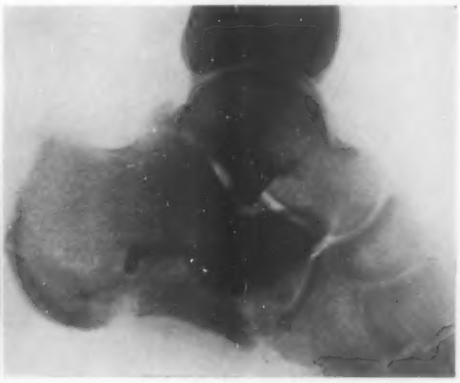

Fig. 5.—Case VI. Mr. O. after operation.

above. Reduction of displacements and fixation in correct position by an agrafe. X-ray proved that reduction was perfect and the normal shape obtained. Normal post-operative course.

Final result is not yet definite, but we publish the case since the X-ray pictures are quite typical. (Figs. 4 and 5.)

The results of the operations done in these cases have been satisfactory. The duration of pains and total disability has been notably reduced. But it should be mentioned that, as in the first two cases operated by Professeur Leriche,* an ankylosis of the posterior astragalo-calcanean joint has followed. Therefore, one might ask, why not at once secure an ankylosis by carrying out an arthrodesis, as has been suggested? Because, first of all, ankylosis might not supervene, and moreover, because the ankylosis following arthrodesis without reduction of the thalamus is an ankylosis in bad position as compared with that following reduction of the depressed articular fragment. Finally, because the open reduction and fixation present no particular difficulty.

* One of these cases has been recently reëxamined by Professeur Leriche. Seven years after operation the result was excellent.

Nevertheless, there are certain cases in which the damage to the joint is too great to allow of proper repair and there are others in which one cannot replace the thalamus.

We have treated one such case in which we were obliged to carry out an arthrodesis.

CASE VII.—R., Paul, eighteen years old, had his right foot crushed, September 19, 1926, by a heavy iron beam, just under the internal malleolus. Brought immediately to the hospital where a fracture of the calcaneus was diagnosed. It was a crushing fracture. The posterior portion of the astragalus had penetrated into the calcaneus, forcing the thalamus into the spongy tissue. The greater process was separated by an oblique line, a large plantar fragment was prominent at the inferior side of the bone and a few splinters projected under the external malleolus.

After five days of immobilization, the patient was operated on by Doctor Simon. Transversal 8-centimetres-incision, about 1 inch under the external malleolus, section of the peroneal tendons, denudation of the external face of the calcaneus, esquillectomy. The fracture line that loosened the greater process was seen clearly. The subthalamic region was all crushed. As the thalamus could not be replaced, an arthrodesis was decided upon. The astragalo-calcaneal joint cartilage was abraded with a thin chisel. The plantar fragment could not be reached by this incision and was left in place. Wound was closed in the usual manner and a gutter case put on.

Normal post-operative course. The case was taken off eleven weeks later and the patient remained in bed three weeks more, mobilizing softly his foot and his knee. After that he got up and walked immediately with the simple help of a stick.

January 20, 1927, he could walk alone without feeling any pain, but was slightly limping on his injured foot which was very much swollen at the end of the day and lightly deviated in valgus. There existed a permanent widening of its posterior third, the normal internal submalleolar depression could not be noticed; the tibiotarsal joint was free, subastragalar joint was blocked. Plantar prints were the same on both sides. There was no muscular atrophy of the leg but the right thigh was 2 centimetres smaller in circumference than the left one. The X-ray showed a diffuse rarefaction of the tarsus; the fracture lines had disappeared. The subastragalar articular interline presented a horizontal direction. It was almost entirely obliterated.

March 20, 1927, the condition of the patient had considerably improved. Evening swelling had reduced; walking was easy and painless.

July 11, 1927, the patient was examined by an expert who estimated the incapacity rate at 25 per cent. The same expert reëxamined the patient October 19, 1928, and on account of a great improvement in his condition, reduced this rate to 10 per cent.

The subastragaloid arthrodesis appears to us to be altogether preferable to primary astragalectomy, as advised in France by Soubeyrand and Rives.[2] Nevertheless, the latter operation is indicated in fractures with complete comminution of the bone when it is impossible to reconstitute the articular surfaces or to do an arthrodesis.

This indication was strictly given in the following case:

CASE VIII.—H., Emile, thirty-nine years old, was brought to the clinic October 28, 1926. He had fallen onto his heels into a very deep hole.

X-ray showed a crushing fracture of the calcaneus; fracture lines could not be clearly distinguished. The posterior part of the astragalus was strongly forced into the calcaneus. The posterior and the inferior outlines of the bone seemed normal (Fig. 6).

November 1 Professeur Leriche found a crushing fracture with multiple fragments. The anterior part of the calcaneus entirely crushed. The astragalus was projected for-

ward head up. Straightening was made impossible by the bursting condition of the anterior articular surface and the outside projection of two fragments. Astragalectomy was performed and the calcaneal surface mended as well as possible. Extirpation of small external fragments; gauze drain; closure of the wound; gutter case.

The patient was kept under observation for a few days and November 23 went home. A new case was put on on December 15, taken off on February 5, 1927, then he began to walk. He reported on March 15, 1927. The foot and the inferior third of the leg were very much swollen. The movements of the ankle had an amplitude of twenty degrees. The patient walked without pain but was in need of two sticks. June 21, 1927, the patient still walked with his sticks and could hardly put his weight on his foot. The œdema had lessened and was localized to the posterior part of the foot and the inferior half of the leg. The new ankle was stiff. The patient was seen again November 19, 1927. He was not suffering any more but still limping and walking with a stick. Slight evening swelling persisted. June 19, 1928, he complained of quick fatigue and slight pain in his foot after a lengthened walk. A trifling œdema of the foot and the inferior third of the leg was still present. Pressure revealed pain in the tibio-calcaneal interline. The foot could scarcely be moved in this interline. Unshod, walking was difficult, but satisfactory with an orthopœdic shoe. The stick was superfluous. The working incapacity was rated at 25 per cent.

FIG. 6.—Case VIII. H., October 28, 1926.

In conclusion we might summarize the lines of treatment of compression fractures of the calcaneus as follows: These fractures must be operated systematically. One is concerned primarily with the correct apposition of the articular surfaces of the astragalo-calcanean joint. To secure this, the thalamus must be lifted, the articular surface repaired and fixed in proper position. Second in importance is the reduction and fixation of the other fragments of the calcaneus. If reduction appears impossible, we must have recourse to a subastragaloid arthrodesis. Finally in certain exceptional cases one is driven to effect astragalectomy.

This surgical treatment has been used more or less accurately by other surgeons.

Nové-Josserand,[3] Cotte,[4] Valls[5] have achieved as well as we have most satisfactory results.

We do not insist on the technic of reduction and osteosynthesis. The particulars of the technic vary according to the lesions met with which are often more severe than X-ray pictures would lead to believe. The horizontal external submalleolar incision gives a sufficiently good access. In raising the thalamus, one must avoid using the inferior part of the calcaneus as a fulcrum since strong pressure might damage the hitherto intact bone.

The means of fixation are sometimes screws, sometimes clips like "agrafes de Dujarier," sometimes screwed-in plates. It seems to us advisable in cases in which a cavity persists under the reduced thalamus to fill this cavity with several osteo-periosteal grafts[6]; this procedure would facilitate consolidation

and thus avoid the long period of osteoporosis which in every instance follows the fractures of the calcaneus.

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[2] Soubeyrand et Rives. Rev. de Chir., t. xlvii, 1913, pp. 429–473.

[3] Lyon Chirurgical, 1928, t. xxv, p. 217, Soc. de Chir. de Lyon, 1 décembre 1927.

[4] Lyon Chirurgical, t. xxvi, p. 115, Soc. de Chir. de Lyon 22 novembre 1928.

[5] La Prensa Medica Argentina, el. 10 de Enero de 1929.

[6] M. Lenormant has, without troubling about the subastragaloid joint, performed this operation a few times; he assigns to these grafts the part of holding up and keeping in place the thalamus after having reduced it first. Bibl.: Bull. & Mém. Soc. Nat. de Chir., Paris, t. liv, pp. 1353–1356.

THE MANAGEMENT OF FRACTURE OF THE FEMUR

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No problem in skeletal surgery has held the medical attention in this first post-war decade more than the treatment of fractures of the femur. In spite of extensive experiences during and following the war, fractures of this bone still remain the most difficult to manage, the most productive of deformity, and the most likely to cause fatalities. The surgical profession is agreed that in all cases of fracture of the femur with overriding, traction of some kind is indicated, yet it is by no means united in its opinions with regard to a standardized form of management or operative methods to be employed; and this diversity of opinion is present not only in the profession in general, but even among men specially trained in handling problems of skeletal injuries. This same lack of standardization obtains with regard to evaluating end-results, causing confusion when one reads reports of end-results expressed in such elastic terms, as fair, good, or perfect.

It follows, therefore, that any attempt at standardization must progress along the path of uniformity of classification (nomenclature), treatment (management), and grading (evaluation of end-results). The easiest way often is the best, and any method that eliminates overmanagement and institutes economy in manipulation eventually becomes the accepted standard. War and post-war experiences have definitely proven that in frankly displaced and overriding fracture of the femur, direct skeletal traction gave uniformly good results.

In 1919, the writer—collaborating with Dr. John J. Moorhead *—made a study of the relative effectiveness of the different types of skeletal traction in overlapped fractures of the femur, in the wards of the Harlem Hospital, and conclusively proved to himself that with the type of patient encountered in a city hospital where often the coöperation by the patient was poor or none at all, transfixion with a Steinman nail gave, by far, the most satisfactory results. Since then, at the New York Post-Graduate Hospital and in private practice, this has been used where traction was indicated.

The following is a report of a consecutive series of 100 unselected cases treated in a uniform method at the New York Post-Graduate Hospital, and follows out the attempted standardization proposed above:

Classification.—For practical purposes, fractures of the femur, as well as fractures in general, can be divided into two main types, based on the presence or absence of displacement of the fragments. Either may be simple

* Surgery, Gynecology and Obstetrics, September, 1920.

or compound. This grouping disregards any differences, such as comminution, direction of fracture line, level of lesion, or the mode of injury.

Group 1.—Comprises the displaced, separated or mal-aligned type in which the fragments are not end to end, but are overlapped in their vertical or lateral axes, and in which reduction is necessary.

Group 2.—Comprises the non-displaced, non-separated, or aligned type,

FIG. 1.—Fracture of femur. Mal-union four months old. 3-inch shortening.

FIG. 2.—Appearance after oblique osteotomy and introduction of nail traction.

in which the fragments are end to end, and not overlapped, and in which reduction is unnecessary.

Thus grouped, or "typed," we convey to the mind differences in amount or quantity rather than actual variety of "fracture," and the pathology of the existing original condition conveys the amount, rather than the variety, of treatment to be instituted.

Further classification follows the anatomical location of the trauma, giv-

ing a qualitative determination, and gives three zones of incidence—those at either articular end of the bone, and those of the shaft. The former are by far most crippling—those of the neck of the femur because of the age and physique of the patient, and those near the condyles because of the difficulty of obtaining and maintaining adequate reduction and the associated injuries occurring in the knee-joint. In considering any classification, we must bear in mind that the basic pathology in fractures is a lacerated wound of bone and attached periosteum, with associated lesions of the soft parts (myositis and teno-synovitis), joints (synovitis, arthritis and bursitis), and vessels (vascular and neural), and that the deformity is produced and maintained by the muscular spasm, and that in setting a fracture, we actually set the muscles, obtaining proper coaptation and alignment of the bone only after the muscular spasm has been overcome.

Thus, quantitatively classified, our series gave the following number of cases: Type 1 (displaced) 54; Type 2 (non-displaced) 46.

Anatomically or qualitatively classified, these cases showed the following varieties:

Upper articular end of bone:		
Neck of femur	14	Females 9—Males 5
Trochanteric	4	Females 3—Males 1
Sub-trochanteric	3	Females 1—Males 2
Shaft of femur:		
Upper third of shaft	24	Females 17
Middle third of shaft	28	and
Lower third of shaft	17	Males 52
Lower articular end of bone:		
Supracondylar	9	Females 1
Condylar	1	Males 9

The greatest zones of incidence are the neck and shaft, and gave 14 per cent. and 69 per cent., respectively, of the total number of cases. The right femur was involved in 55 per cent, the left in 39 per cent, and bilateral 6 per cent.

The age incidence was as follows: First decade, 22 per cent.; second decade, 19 per cent.; third decade, 12 per cent.; fourth decade, 15 per cent.; fifth decade, 14 per cent.; sixth decade or over, 18 per cent.

There were 64 males, 36 females, and 24 children. The youngest case was nine months, the oldest ninety-two years. The oldest neck of femur case was ninety-two years, the youngest forty-one years.

Duration of the fracture on admission: One day, 29 per cent.; three days, 26 per cent.; one week, 10 per cent.; two weeks, 6 per cent.; one month, 15 per cent.; three months, 7 per cent.; six months or more, 7 per cent.

Associated lesions present were as follows: Both femurs, 8 cases; one femur with tibia and fibula, 4 cases; one femur with patella, 1 case; one femur with pelvis, 1 case; one femur with surgical neck of humerus, 1 case.

Treatment.—Before approaching the problems of treatment, several cardinal considerations present themselves for our attention, as follows:

1. *Time of Reduction.*—This is of prime importance, as early reduction means more accurate and easier reduction; and preliminary traction, irrespective of subsequent treatment, is of great aid toward this end. The presence of swelling is no contraindication to reduction.

2. *Correct Coaptation.*—This leads to a minimum amount of callus, for

FIG. 3.—Lateral view with nail traction in situ.

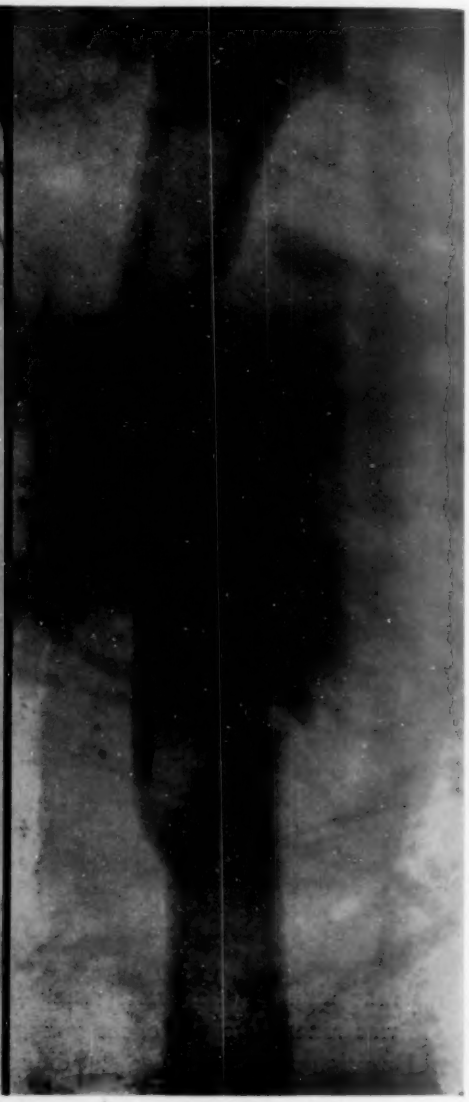

FIG. 4.—Appearance four weeks after removal of nail traction.

a lacerated bone, like any other laceration, will heal by primary union if the edges are well approximated; whereas non-approximation will lead to secondary union and excessive callus.

3. *Compound Fractures.*—Experience has taught us that we can convert a compound fracture into a simple one by mechanical sterilization which

aims to expose the fracture site to vision by the excision of all the damaged and devitalized tissues. This débridement and primary suture is reserved for selected cases, and we do not practise it when the injury is more than twenty-four hours old. The safest procedure in converting a compound into a simple fracture is to resort to primo-secondary or delayed suture in which all steps, except suture, are taken and the actual suturing is performed after the third day when we are assured clinically and bacteriologically of the asepsis of the wound. An already infected fracture is a problem in osteomyelitis, and treated as such.

4. *Introduction of Non-absorbable Materials.*—We accept as a "necessary evil" the occasional use of non-absorbable material to act as an internal splint, but it should be the last resort, even in selected cases. Infection after plating or wiring is a regrettable occurrence in the leg or arm—in the thigh it has often been a tragedy.

5. *Articular Activity.*—With intra-articular fractures, or fractures very near to a joint, early active motion is of the utmost importance. Immobilization in the case of hæmorrhage into the joint will cause fibrinous adhesions which at length become fibrous. Intra-articular fibrous bands lead to bony ankylosis. Active motion causes the blood to be absorbed quickly and keeps the joint in a supple condition. For this reason, in any fracture near a joint with a concomitant synovitis, a preliminary aspiration of the joint is our routine. The hip-joint is the only exception to this rule.

6. *Non-union.*—This really means mal-union, the result of faulty reduction or retention. The next commonest cause for non-union is interposition of soft or hard parts (muscles, fascia, tendon, bone, etc.), and is in effect a spontaneous arthroplasty. Syphilis we believe not to be a common cause for non-union, for if it were so, non-union would be more common than it is. But we do believe that cardio-vascular disease, as well as focal infection, is a considerable factor in this process. As to frequency of non-union, the femur is fourth on the list, beginning with tibia, forearm, and humerus. Non-union of the fibula is a rarity, and is possibly explained by the large nutrient canal it has. Non-union in any joint fracture, except fracture of the neck of the femur, is exceedingly rare.

7. *Repair.*—All the above considerations are contributory factors in the process of repair. It is of note, however, both in time of occurrence and amount of deposition, that callus appears first and in greater quantity on the concave aspect of the shaft of the bone, demonstrating an engineering principle that the greatest support is given at the point of greatest strain. The antero-posterior curve of the shaft of the femur creates an arch with the weakest point about the middle of the bone—the point of greatest stress and the most common site of fracture of the shaft. Therefore, the importance of getting correct coaptation for the production of a strong bony repair.

These are some of the essential principles—they are the foundations upon which our treatment is based. What, then, has been our experience in treating this group of cases? Briefly stated, the answer is that all cases of frac-

ture of the neck of the femur are treated by adhesive traction and extension in a Gatch bed, and all others of the Type 2 (non-displaced) are treated in a plaster-of-Paris cast or in a Thomas or Blake-Keller splint. All Type 1 fractures below the neck are treated by transfixion.

Neck of Femur Group.—Generally speaking, patients with fracture of the femoral neck—using their age and physique as a standard—can be arbitrarily divided into three classes of risks—the good, the fair, and the poor—and treatment is accorded with this grouping in mind.

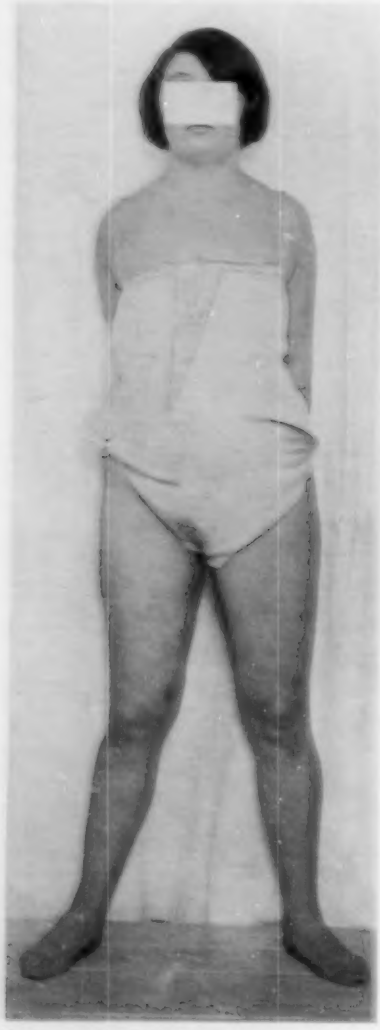

FIG. 5.—Functional end result three years later. One-quarter inch shortening.

Those in the fair and good groups, because of a tolerant physique, may be placed in an abduction plaster-of-Paris case, following traction and extension in a Gatch bed. This preliminary application of traction facilitates reduction by tiring the muscles in overcoming spasm, and allowing of easier manipulation of the fracture.

Where the physique is poor or bad, any confinement in a fixed position may prove a catastrophe. Therefore, in some cases all that need be done is to place a pillow or sandbag along the outer side of the limb to prevent external rotation. Where displacement is present, placing the patient in a Gatch bed with the knee flexed and the thigh internally rotated with a weight of 5 to 20 pounds attached to it by means of adhesive straps led over the foot of the bed, which is elevated about twelve inches, will often reduce the overriding and maintain the fragments in apposition to allow of union. Any of these means will tide a patient over the stage of shock, hypostatic pneumonia, or other medical or surgical complication. Later, when conditions permit, a plaster-of-Paris abduction case may be applied, or this same mode of traction and extension may be maintained until union is established. Lately, we have been using this throughout the entire period of treatment, and found that union often occurred earlier and was stronger than when immobilization in a case was used.

When the abduction case is used, it is left on for six weeks and then removed, examining the fracture site for the presence of union which often is of sufficient strength to allow the patient to be up and about in a pair of

walking callipers (Thomas splint with waist band) and crutches. This permits of locomotion, but no weight-bearing, and early access for massage of the different parts of the limb. This is worn until union is solid, by which we mean that weight-bearing on the extremity will not give a reaction at the fracture site in terms of pain, swelling, or disability. We differentiate between early and late union. The former we call firm when the patient is able to elevate the foot off the bed, and the latter we call solid when no reaction is given at site of fracture as above.

Many patients can discard the brace at the end of four months, but the majority need some support for six months. If, when the case is removed, no evidence of union is present, a new plaster case is applied and left on for four weeks, at the end of which time in most cases union will be present.

FIG. 6.—Dimple above external condyle of right femur shows site of entrance of nail.

Fractures Below the Neck.—As previously stated, all Type 2 (those with non-displaced fragments) are treated in (1) a plaster-of-Paris case (2) an anteroposterior moulded plaster-of-Paris splint, or (3) in a Thomas or Blake-Keller splint. The fragments in this group are not overlapping, hence there is no gross deformity, the bones are aligned and the carrying angle is correct, and our aim is to hold the position unchanged until there is firm union. For, it is reasonable to assume that, if the violence of the accident caused no displacement of fragments, any subsequent displacement will result only by injudicious management.

All Type 1 (those with displaced fragments) are treated by transfixion unless the musculature of the individual is frail or the displacement of the fragments is small, when reduction can be accomplished readily on one of the traction tables. Transfixion is applied as soon as possible, and general anæsthesia is preferable, but spinal or even local anæsthesia can be used. Of the general anæsthetics, we prefer the following in the order given: Nitrous oxide, ethylene, or by drop method, ether or ethyl chloride.

Site of Election.—For shaft fractures, this is about two and one-half inches above the condyles. For supracondylar fractures, through the condyles, and for condylar fractures, through the head of the tibia. The bony landmark in each site is the internal condyle.

Introduction of Nail.—The flexed and iodinized knee is rested at an angle

of 165° over a sandbag. At the site of transfixion, the skin is drawn upward and a vertical incision one-half inch long is made on the outer side of the limb on a line bisecting the greater trochanter and external condyle. A director is introduced into the incision and the center of the bone located. This is important as otherwise the popliteal space, or the synovial area may be entered. The three-sixteenths inch transfixion nail (Steinman nail) is then introduced over the director, which is then removed, and with gentle repeated tappings with a bone mallet, the nail is passed through the bone, while an assistant steadies the part and maintains counterpressure, making sure all the time that the nail is being held at right angles until it transfixes the bone and impinges against the skin on the inner side opposite the place of entrance. The skin here is now also drawn upward, and an incision one-half inch long also made and the nail allowed to pass through at the top of it. Any pressure by the nail upon the skin will cause acute pain; hence the caution to prevent this by drawing the skin upward before making the incisions. At least one inch of the nail is allowed to project on either side of the limb.

After Care.—The nail being introduced, the skin wound is covered with a wet dressing of a mild antiseptic, and for this purpose we use a solution of iodine, dram 1, to sterile saline, pint 1. Dry gauze and cotton are applied over this after the "spreader" has been fastened to the ends of the nail and bandaged over to form a fairly secure but not too tight dressing, allowing for freedom in flexion of the knee. This dressing is changed at the end of forty-eight hours, and again every other day for ten days, until the nail is removed. There will be more or less serum around the skin wound due to irritation of the nail, but seldom any infection.

Thus secured, traction is maintained on the lower fragment while the patient is being transported to bed, which is elevated twelve inches at its foot. A cord passes over the pulley at the foot of the bed, and a weight of thirty to forty pounds is attached to the end of the "spreader." Both knees are kept at an angle of 165°—that is, just off a straight line—and the direction of traction is always in the long axis of the upper fragment. To keep the knees properly flexed, we use (1) a bolster passed under the mattress, (2) a Gatch bed, (3) a Thomas splint with a knee piece, or (4) a Hodgen splint.

An overhead frame of the Balkan type will give the best type of support for the apparatus, and also provides a "perch" for the patient to pull upon. Attention to the knee-joint motion is given from the start, as the patient is provided with an overhead cord which is fastened to the ankle or to the sole of the foot, and daily the knee-joint is moved by the patient so that any fixation of the joint from the accompanying synovitis is avoided.

In supracondylar fractures, it is always advisable to flex the knee somewhat beyond 165°; otherwise the gastrocnemius will continue to contract, thus interfering with coaptation. In the sub-trochanteric and upper third of the shaft regions, the upper fragment will be in abduction, and hence the direction of traction must follow this direction by placing the traction cord,

pulley, and weight, so that wide abduction is possible. A good plan in obtaining this is to have the patient's foot on the injured side on a line with the umbilicus and opposite shoulder. Flexion of the knee automatically flexes the thigh on the abdomen, and thus the contraction of the ilio-psoas group is relaxed by the same procedure which relaxes the gastrocnemius group.

Periodic examinations of the limb will determine whether or not overlapping has been overcome, and when false motion, crepitus and laxity of the muscles are noted, measurement or X-ray examination will show that the deformity has been overcome or sometimes even a separation of the fragments created. With this established, the traction is discontinued and the nail removed. This is done by flaming the end of the nail to be pulled through, or sterilizing it with tincture of iodine, and, with an artery clamp applied to the opposite end, a gentle rotary motion will free the nail, making its removal easy.

After the removal of the nail, a sterile dressing is applied to the sites of entrance and exit of the nail, and a cast is applied to the limb, reaching from the hips to, and including, the toes. This is left on for four weeks, at the end of which time it is removed and the site of the fracture is examined for the presence of union. This we call "firm" when manipulation gives no evidence of false motion, and "solid" when weight-bearing gives no local reaction in terms of swelling, heat, or pain. If firm union is present, the plaster case is left off, and a pair of walking callipers is applied which the patient wears constantly until unaided weight-bearing is established.

With the application of the walking callipers, physiotherapy is at once instituted, and maintained up to and beyond the time that it is removed, so that when the protective brace is discarded—which is anywhere from two to four months after its application—the patient has a fairly good functioning limb well on towards the ultimate goal in the treatment, a good functional end-result.

In the 100 cases reported here, traction was used in 54 cases, and non-traction in 46 cases.

Skeletal traction was used in 42 cases as follows:

Steinman nail	39 cases	Males 34, Females 5. Of these 4 were children under twelve years.
Traction callipers	2 cases	
Finnochietto stirrup	1 case	

Adhesive traction (neck of femur cases) was used in twelve cases.

Site of Nail Traction: Shaft of femur, 32 cases; head of tibia, 6 cases; os calcis, 1 case.
Average duration of nail traction was 17 days.
Longest duration of nail traction was 38 days.
Shortest duration of nail traction was 4 days.

Average duration of traction callipers was twenty-nine days.

Duration of stirrup traction was thirteen days.

The oldest patient on whom a nail was used was seventy-one years old; the youngest, nine years.

The average duration of post-traction immobilization in plaster-of-Paris case was forty-two days; longest ten weeks; shortest thirty-six days.

Operations performed:

Oblique osteotomy for mal-union with transfixion..... 9 cases
Open correction without nail..... 6 cases
Amputation ..... 1 case
(Admitted with osteomyelitis of femur and sepsis with spontaneous fracture—pathologic)
Complications.—One case of osteomyelitis of nail passage due to use of short nail. One case of osteomyelitis of nail passage due to too long retention of nail.
Deaths.—One case admitted with fracture of neck of femur, broncho-pneumonia—age eighty-one years. Died within forty-eight hours.

Grading or evaluation of end-results is an attempt to give numerical standards to the desired triad in the treatment of fractures; *viz.*, function, union, and contour; and because we feel that function is the most essential of these, we give it a valuation of 60 per cent. out of a possible 100 per cent. To union and contour, we give a valuation of 20 per cent. each. These standards, to be sure, are arbitrary but give a numerical uniformity of understanding end-results, and are—to our minds—far more satisfactory in producing a fixed basis of comparison, than the elastic terms of fair, good, or perfect.

An attempt at follow-up was made on the cases reported, and only twenty per cent. responded. Letters of inquiry with questionnaires were sent out to the remaining 80 per cent., but answers proved insufficient as a basis for report. Of the twenty patients that showed up, the post-treatment time ranged from one to seven years. Twelve of those who reported were treated by transfixion with the nail; eight were non-traction cases. The anatomical lesions of those that reported were as follows:

Skeletal Traction:		*Non-traction:*	
Shaft of femur	9 cases	Shaft of femur	5 cases
Supracondylar	3 cases	Neck of femur	3 cases

Graded by types, the twenty cases gave the following findings:

No.	Type	Func. Per cent.	Union Per cent.	Cont. Per cent.	Total Per cent.
1. Case 2—Middle shaft—Nail traction.....	1	50	18	10	78
2. Case 3—Shaft—Non-traction	2	55	20	15	90
3. Case 5—Neck of femur	2	60	15	20	95
4. Case 10—Left neck and right lower third—Nail traction	1	30	10	15	55
5. Case 18—Supracondylar—Nail traction	1	60	15	20	95
6. Case 35—Middle third, shaft—Nail traction.	1	50	20	15	85
7. Case 39—Neck of femur—Non-traction	2	50	15	15	80
8. Case 42—Lower third—Nail traction	1	45	15	15	75
9. Case 48—Upper third—Nail traction	1	55	20	15	90
10. Case 50—Neck of femur	2	40	10	15	65
11. Case 52—Upper third—Nail traction	1	55	20	15	90
12. Case 53—Supracondylar—Nail traction bilateral	1	35	12	15	62

No.	Type	Func. Per cent.	Union Per cent.	Cont. Per cent.	Total Per cent.
13. Case 57—Lower third—Nail traction	1	35	15	15	65
14. Case 60—Upper third—Nail traction	1	55	20	20	95
15. Case 67—Middle—Nail Traction	1	50	20	20	90
16. Case 70—Upper third—Non-traction	2	55	20	20	95
17. Case 83—Middle third—Non-traction	2	60	20	15	95
18. Case 89—Supracondular—Nail traction	1	40	15	10	65
19. Case 94—Lower third—Non-traction	2	55	20	20	95
20. Case 98—Upper third—Non-traction	2	55	20	15	90
Total average		47	17	16	80

RESUMÉ

1. Uniformity of classification, treatment, and grading—as followed in the above series of 100 cases of fracture of the femur—is a step toward standardization in the management of all fractures.

2. Judged by this series, fracture of the femur seems to be an injury occurring more in adult life than childhood—the proportion being about three to one.

3. Fracture of the neck of the femur is more common in females, whereas fractures of the shaft occurs more commonly in the male.

4. Transfixion with the Steinman nail in displaced fractures of the shaft or supracondylar region has given uniformly good results in all of the thirty-nine cases tried.

5. In old fractures, with mal-union and shortening of the bone, it is the best means at our command in overcoming contracture of muscles, if applied after the separation of the mal-union by osteotomy.

6. In non-union due to interposition of soft parts, it will often—by pulling down the lower fragments—release the interposed part and allow manual adjustment of the fragments without resorting to an open operation.

7. There was no breakage of the nail.

8. No infection occurred at the transfixion site, except in two cases due to the use of a short nail and too long a traction time, respectively.

9. With the use of a moderate amount of care, the introduction of the nail is a relatively simple procedure, and may be done at the patient's bedside.

10. Transfixion treatment in supracondylar fractures by allowing movement in the knee-joint prevents fibrous adhesions, with a consequent earlier restoration of knee-joint function.

11. This series of typical cases would indicate that the treatment of fracture of the femur resolves itself into the following:

(*a*) Children up to five years to be treated by overhead suspension.

(*b*) Fractures of the "neck" zone to be treated by traction and extension in a Gatch bed.

(*c*) Fractures in all other zones of the displaced type to be treated by skeletal traction, of which transfixion is our choice.

Note: The writer is indebted to Dr. J. J. Moorhead, director of the Department of Traumatic Surgery, the use of whose cases made possible the greater part of this paper.

TREATMENT OF FRACTURE OF THE NECK OF THE FEMUR IN THE AGED

By John E. Cannaday, M.D.
of Charleston, W. Va.

The appropriate treatment for fracture of the neck of the femur depends to a very great extent on the age and general condition of the patient. I believe it is generally conceded by the surgical profession that the aged or otherwise feeble individual having a fracture of the neck of the femur constitutes a special problem. It is commonly said, and with good reason,

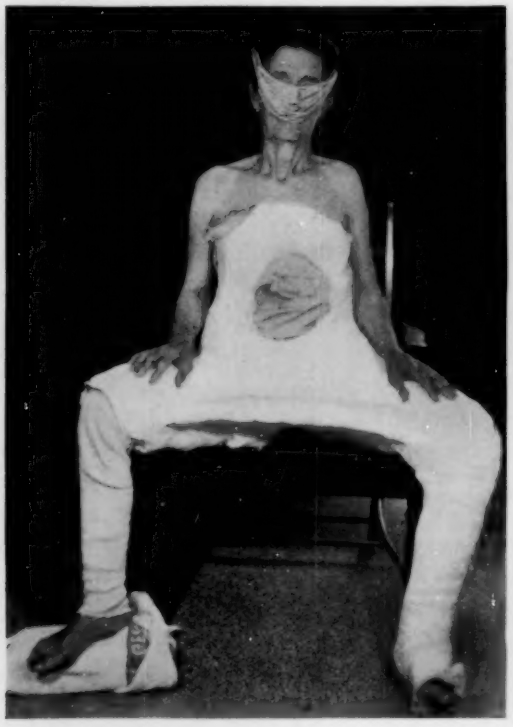

Fig. 1.—Plaster-bandage fixation of fractured neck of the femur. Anterior view.

Fig. 2.—Plaster-bandage fixation of fractured neck of the femur. Side view; sitting posture.

that it is dangerous to confine an old person to bed. Two serious complications are often incidental to fracture of the neck of the femur in the aged: Pneumonia and bedsores. The former presumably often starts as a hypostatic process. In such patients the advantages of an ambulatory or semi-ambulatory method of treatment are obvious. Again, particularly in case of female patients, who are being kept on the back, it is often difficult to prevent soiling of the plaster case during the act of urination; certainly so if a bedpan is used; the same problem arises after the administration of an enema.

Many surgeons have advocated treating these patients by the use of traction or sandbags, or both, meanwhile keeping them on their backs. My observation is that if such patients escape pneumonia they usually develop bedsores. In the treatment of such cases occurring in my service in the Charleston General Hospital, I have for the past several years advocated and practiced the application of a plaster case in a modified Whitman position. I call it the sitting Whitman position. The position is somewhat like the position used after the reduction of a congenital dislocation of the hip.

In these cases, it is advantageous to apply the case early after the fracture, before overmuch muscle contraction has taken place. Before applying the case, if practicable, the leg should be brought down by traction so as to compare in length with the other leg. On the fracture table, the legs are placed in a position of rest, the thighs flexed on the body at a right angle

FIG. 3.—Patient supine.

and the legs at right angles to the thighs, the thighs abducted in the Whitman position. The fractured limb is held in internal rotation as well, the Hawley or other fracture table supporting the patient's hips, shoulders and knees. The case starts at mid-chest, includes a spica of the pelvis, thigh, leg and foot as well as the thigh of the unaffected side. The legs are held in position by assistants. Meanwhile traction should be made in line with the body by a bandage pull around the upper part of the thigh so as to overcome any tendency of the femur to slip upwards. The case is applied in sections—first, the body, spica of the pelvis and thighs, then the transverse spreader bar between the knees, the leg and lastly the foot; all at one sitting of course. A preliminary hypodermic of morphine obviates any necessity for general anæsthesia. In order to expedite the application of the case and thus to conserve the patient's strength, the services of a well-trained team of six or seven individuals are desirable.

As one infers from the photographs (Figs. 1–4), the patient can be easily shifted into numerous positions. The sitting and prone positions seem to be the most comfortable in the average case. As the patient has the liberty rather than the confinement of a case, a surprising degree of physical well-being is maintained. As a rule, we find it desirable to change the patient's position every two or three hours or oftener if the patient is not comfortable. Most of the patients sit up in a chair for the major portion of each morning and afternoon, the meals are usually taken in that position, reading or some variety of handwork helps to keep up the morale of the patient. Old people are often hypersensitive to pressure from a case and unless the case is applied with extreme care by one familiar with such procedures, the patient will not be comfortable.

In the aftercare, it is essential to have the services of a nurse who understands how to make her patient comfortable by means other than a hypo-

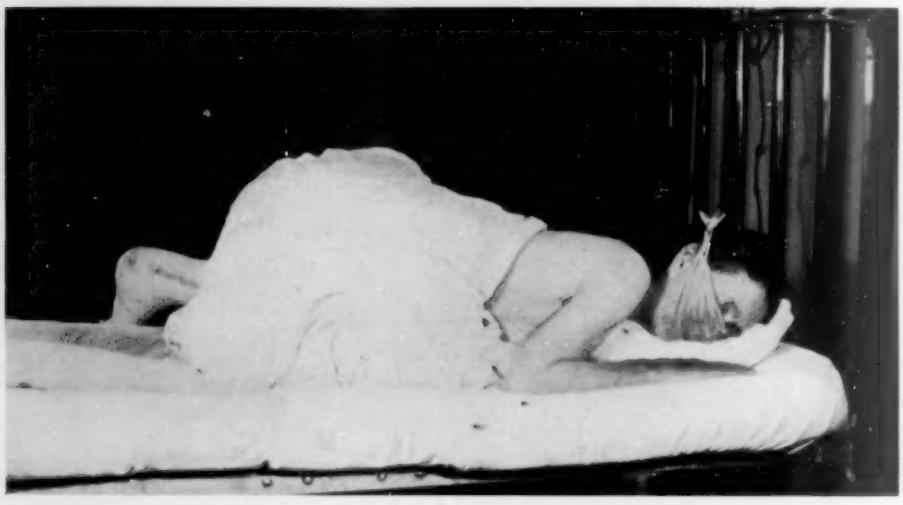

FIG. 4.—Patient prone.

dermic of morphia. Change of position often is all that is necessary to relieve the pain and discomfort incident to the condition. Most of our patients have obtained bony union; neither bedsores nor hypostatic pneumonia has occurred when the case has been properly applied and the patient has had reasonably intelligent care

The knee is usually freed at the end of the sixth week, at which time the spica of the well thigh and the spreader bar are also removed. The remainder of the case is removed seven or eight weeks later. Previous to the removal of the case from the foot and leg so as to allow free knee motion, a window is cut anteriorly in order that the patella may have the benefit of passive motion—as is obvious, if the knee is kept fixed for an undue length of time there will be soreness and stiffness that may require considerable time and effort to overcome. No stiffness or ankylosis of the knee or hip joints has been noted in any case handled in strict accordance with the above outline.

EXPERIENCES WITH VENOCLYSIS *

By George A. Hendon, M.D.
of Louisville, Ky.

I had the privilege of reporting my earlier work with this mode of intravenous administration before the Southern Surgical Association at Charleston in December, 1924. At that time I first proposed the word "venoclysis" as definitive and descriptive of the process I was advocating. As no better, in fact no other, term has appeared, I still adhere to its use. It is a pleasure for me to remind you by a repetition of the acknowledgment of credit which I gave at that time to Matas, who originated the idea. The following is a quotation from my article: "On May 12, 1924, I first employed the method and again in June, 1924, as a result of a paper on the 'Continuous Intravenous Drip' by Dr. Rudolph Matas, read before the American Surgical Association in June, 1923." The paper was published in the Annals of Surgery in May, 1924.

My first case was in May, 1924, before the appearance of Matas' article, but I had seen more or less condensed extracts that had winged their way through the current literature of the intervening period. Those who may be interested in the fundamental principles involved are referred to my article in the *Transactions of the Southern Surgical Association* for 1924 and to Matas' original contribution in the Annals of Surgery for May, 1924.

There are a few historical points of interest concerning intravenous administrations that seem to be of sufficient importance to include in this presentation. The first account we have of intravenous medication is found in Boyle's book on the "Usefulness of Experimental Philosophy" published in 1720, a quotation from which is herein produced. The experiments noted here were done in 1656.

> I may here mention some later experiments made to show the effects of liquid poisons conveyed immediately into the blood, and particularly that famous one of Mr. Christopher Wren, who contrived a new way of injecting them. I procured a large dog, into the vein of whose hinder leg we conveyed, by a syringe, a small dose of warm solution of opium in sack. The effects whereof became manifested as soon as we could loose the dog from the cords wherewith his feet were tied, for he immediately began to nod and reel as he walked, whereupon, to preserve his life, I ordered him to be kept awake by whipping, which after some time brought him to himself, so that he soon grew fat upon it. The same gentleman at another time, injected in the same manner about two ounces of Vinum Benedictum, which operated so violently that it soon killed the dog.†

It is astonishing to note that the Mr. Christopher Wren, mentioned in this connection, afterwards became Sir Christopher Wren, the famous architect who designed and built the dome of St. Paul's. It is noteworthy indeed,

* Read before the Southern Surgical Association, December, 1929.

† Robert Boyle: *The Usefulness of Philosophy*, vol. i, p. 38.

that at the age of sixteen he was prosector of anatomy to Doctor Scarborough at Oxford.

Dr. J. M. Fortescue-Brickdale, in Guys Hospital Reports, vol. lviii, 15-8, has presented the history of intravenous medication to 1904. The high points are as follows: Wren, 1656 (on animals only); Hayem used saline infusion for cholera in 1855; Bacelli used quinine infusion for malaria in 1890; Crede used colloidal silver injections for infections in 1901. Since that time intravenous medication has become universal and generally understood. But intravenous nutrition to the exclusion of all other efforts to supply nourishment might be acknowledge to have begun with the case I treated in June, 1924. Our experience has demonstrated beyond any doubt that venoclysis renders one entirely independent of the gastro-intestinal system so far as nutrition and liquidation is concerned. When the ease, safety and simplicity of the procedure is more generally and more thoroughly appreciated, venoclysis will become the method of medication in most serious and acute diseases. For our own convenience we have devised a cannula made of silver and plated with gold, to prevent corrosion. The point is rounded and blunt and there are openings in the sides and none at the end. This we believe renders it less liable to become clogged by a clot of blood or loose tissue. Should a clot form and become dislodged it would not go directly into the current of the fluid but would be more likely to adhere to the wall of the vessel because of the close contact of the cannula.

FIG. 1.—The cannula.

The technic is to expose either the basilic or the cephalic veins (preferably the basilic) immediately above the bend of the elbow under local anæsthesia after a tourniquet has been applied to arm above. With an aneurism needle a piece of umbilical tape of convenient length is carried beneath the vessel. The distal end is tied with a catgut ligature before the vein is opened. The vessel wall is then picked up, the tourniquet loosened and the vein wall opened with a manicurist instrument called "cuticle nipper." The cannula is introduced into the vessel lumen beyond its shoulder and the vein tied behind its shoulder with umbilical tape and tied in front with the same material. Before the operation is started the apparatus should be assembled and the bottles filled with the solution which is intended to be employed. The fluid is allowed to flow until the air is expelled and the connection is then made to the cannula with a piece of rubber catheter or other high-grade tubing about four inches long. I find it useful to purchase Eyenard catheters and cut them into convenient lengths for that purpose because they seem to be composed of highly vitalized rubber which renders the connection thus made easy of accomplishment and assured security. The flow is now allowed to begin in a small stream for a few moments to insure the patency of the cannula. It is then throttled down to the required rate and the wound is closed with catgut sutures. A sterile gauze dressing is applied over the incision, the tubing bound tightly to the forearm with

strips of adhesive plaster that encircle the limb at intervals down to the wrist. A loop of muslin bandage is carried lightly around the wrist and tied to the bed railing to prevent damage being done by involuntary movements during sleep. Splinting is not necessary. The patients may assume any position in bed that they desire.

The apparatus for holding and conveying the fluid consists essentially of two thermos bottles, quart size, and a staff about six feet high to suspend them. The bottles are provided with brackets made of wire that will permit them to be suspended in an inverted position and with Wolf stoppers containing two holes, one for an air tube and the other to provide an outlet for

FIG. 2.—The venoclysis apparatus in operation.

FIG. 3. — Venoclysis; showing possible self-regulation of supply.

FIG. 4.—Venoclysis; showing possible natural position for taking nutrition.

the fluid. Over this tube is fitted a piece of stethoscopic rubber tube about ten inches long. The other end is fitted over one arm of a glass Y. The opposite limb of the Y is joined in the same manner to a similar piece of tubing which is also attached by its other end to the tube in the second bottle. Each segment of the tubing is provided with a stopcock regulated by a screw. The stem of the Y is joined to another section of stethoscopic tube about three inches long, to the other end of which is joined a Murphy visible dripper and in the middle of the tube is a stopcock similar to the above. The lower end of the dripper is in turn joined to another piece of stethoscopic tubing about twenty-four inches long at the lower end of which is attached a glass irrigating nozzle to connect with the piece of catheter that joins the cannula.

The equipment can all be sterilized by boiling except the thermos bottles. These I keep filled with Dakin's Solution while they are not in use; immediately before using them I pour out the Dakin's and rinse with sterile water.

The rate of the flow is regulated so that the patient, if an adult, receives not less than four thousand nor more than six thousand cubic centimeters of 10 per cent dextrose in twenty-four hours. It is interesting to observe that the urine output is in most cases approximately one-half the amount of fluid thus administered.

The fluids used are sterilized in the usual way. When using dextrose solution we employ the anhydrous product and dissolve only enough at a time to last twenty-four hours as it undergoes decomposition when kept longer. The dextrose solution will not admit of boiling but can be sterilized by exposing it to 15 pound steam pressure for ten minutes. If a dextrose solution turns brown it is unfit for use.

We have at different times and in different cases used Ringer's solution, Fischer's solution, normal saline, dextrose in normal saline and dextrose in plain sterile water. Much experience and the reports of many observers will be required to furnish information as to the numbers of remedies that can be best administered in this way. Our own experience has only proceeded far enough to supply assurance that the method is safe, simple and accurate. Formerly maintenance of the proper temperature was a matter of much concern. We usually aim to deliver our fluid to the vein at 100° F. That requirement is easily met by placing it in the thermos at 120°, or by calculating so as to allow a loss of 5° F. in transit for each foot of tubing traversed. In case of shock or subnormal temperature fluid can be supplied to the blood at 120° F. without hæmolysis and is of immense value in restoring body heat, thereby relieving algid conditions. The fluid can be administered by venoclysis, at room temperature or as low as 60° F., to control excessively high temperatures. As to rapidity of administration I have found it practical to give 150 to 200 cubic centimeters per hour.

Increased lachrymal secretion or œdema of the lids is regarded as evidence of saturation. I have seen only one case. The quantity is then reduced or the flow discontinued. If dextrose is being given the urine is examined daily and as long as only a trace of sugar appears the administration is not disturbed but when percentages occur even 1 per cent the concentration is diminished. We find that any toxæmia whatever will consume large amounts of dextrose. I have given 600 grams of dextrose in eighteen hours in a severe case of septicæmiea and 500 grams daily for five days in pernicious vomiting without any glycosuria but with immense relief of pain and much benefit to the patient. While in a case of gastric ulcer that I treated, 250 grams daily was all the patient could take without the sugar appearing in the urine in 1 or 2 per cent proportions. The glycosuria we do not regard as a danger signal. The concentration is reduced, however, because there could be no useful purpose accomplished by allowing an excess of sugar to circulate in the economy.

In an experience covering a period of six years and more than 150 cases I have never met with a serious accident or grave complication that could be ascribed to or connected with this method of treatment. Neither air embolism nor clot nor phlebitis has appeared as a complication and the operation wounds have healed perfectly and promptly without undue soreness or disability in the arm. Neither has the circulation become in the least embarrassed by the destruction of the vein that was employed. The cannula is easily removed when the treatment is completed. No bleeding follows its withdrawal because the vein in which it was lodged ceased to function as a conveyor of blood as soon as the fluid began to flow through it to the general circulation. I shall report briefly a few cases with the most surprising results.

In my list are eleven cases of emesis gravidarium upon whom some of our best obstetricians had used all the known methods of treatment except the induction of abortion. These women, one of whom was unconscious when the treatment was begun, was given 5,000 cubic centimetres daily of a 10 per cent solution of dextrose. They were under treatment from three to five days. All recovered. One of them died four weeks after going home from intestinal hæmorrhages of undetermined origin. She was in the fifth month of her pregnancy.

Case XII was a woman who had been ill seven weeks with a staphylococcic blood-stream infection with irregular chills and temperature ranging from normal to 104°, excessive diaphoresis, exhaustion and very rapid pulse. After seventy-two hours' treatment, during which time she received 15,000 cubic centimetres of a 10 per cent dextrose solution her temperature became normal with the exception of an evening rise to 101°, which continued but a few days. No other treatment was employed. She left the hospital in two weeks completely recovered and has since regained her natural weight and strength.

Case XIII was a woman who had been sick about a year with what her physician diagnosed as pernicious anæmia. All the known methods of treatment, both medicinal and dietetic including liver feeding, had been tried in vain. Her blood count was one million and nine hundred thousand. Her revulsion for food was so intense that she was literally starving. Extreme muscular exhaustion prevailed to such an extent that she was unable to turn over in bed without assistance. After seventy-two hours of treatment in which we gave 15,000 cubic centimetres of a 10 per cent solution of glucose her red blood cells rose to two million and five hundred thousand. She began to eat normally, the count rose in a few more days to three million and she has gained forty pounds in weight.

Case XIV was a man suffering with intense jaundice, sick four weeks, severe pain, irregular chills, temperature ranging as high as 104°. His abdomen was opened under the diagnosis of obstructive jaundice; a stone was thought to be lodged in the common duct. Instead of that was found a condition of multiple abscess of the liver with no obstruction of the duct. The gall-bladder, which was opened, contained about one dram of normal-looking bile. A tube was placed in the gall-bladder for drainage but nothing flowed from it until about one week after the operation. In three days his jaundice had disappeared and he proceeded to complete recovery but was attacked two months after operation with severe recurrent pains in the upper right quadrant. His abdomen was

again opened and the gall-bladder removed. The liver which was at the previous operation very much enlarged and very soft now appeared normal in size and consistency. The patient made a prompt recovery and has remained so except an occasional attack of pain in the upper right abdominal quadrant, the cause of which I am not able to determine. He is now fully recovered and working regularly at his trade as a plumber.

CASE XV was a man who had suffered an avulsion of the left arm at the shoulder-joint by being caught in the machinery of a cement mill. He was unconscious and in profound shock. As soon as he could be gotten to the operating table the venoclysis with a 10 per cent solution of dextrose was begun and continued while the flaps were being fashioned and adapted to cover the head of the scapula. The nerves and tendons stripped of their coverings hung down to his waist and presented a gruesome spectacle. These were trimmed smooth and the axillary artery tied. The skin margins approximated so that a very presentable stump was obtained. The venoclysis was continued forty-eight hours, at the end of that time all evidence of shock was gone and the patient made an unusually quick recovery.

CASE XVI was a girl twenty years old, who had suffered with osteomyelitis of femur since childhood. She had undergone numerous curettements. She had several discharging sinuses. The limb was totally useless. She came to me requesting an amputation. I did not suppose she could endure a hip-joint disarticulation so I amputated through the continuity of the shaft as high up as I could without invading the joint. The bone being in a state of septic necrosis when sawed through naturally infected the operative field. The evening of the second day her temperature rose to 104°, pulse 140, and she became delirious. Venoclysis was then started with 10 per cent dextrose. Six thousand cubic centimetres were given in eighteen hours. Her temperature came down to normal and pulse to 100. The venoclysis was now discontinued. Her temperature remained at normal with a slight evening rise. She made a complete recovery.

CASE XVII.—Mrs. W. had been operated on one and a half years previously for gastro-duodenal ulcer. A gastro-enterostomy was done. She derived some temporary relief but her former symptoms returned in all their original severity, including one very alarming hæmorrhage. It was decided to give the stomach and duodenum a period of complete rest before attempting any more surgery. After a thorough understanding of what we proposed to do and the purpose had been explained as well as the novelty of the procedure we started her off on a 10 per cent solution of dextrose at the rate of 5,000 cubic centimetres a day. No other form of nutrition was allowed. About the second day her urine showed 2 per cent sugar and the concentration of the solution was reduced to 5 per cent. From thence forward her urine showed only a "trace" of sugar. After six days her arm began to show some redness about the cannula and became slightly painful, upon which it was decided to transfer to the other arm. A rest of two days was allowed, during which time she was fed on cereals with cream and sugar. When the treatment was begun again, all gastric feeding was discontinued and the treatment continued seven days. The patient was then fed on cereals with gradual expansion of diet and she felt so much relief she declined operation and her improvement has continued since her return home. Now fourteen months have elapsed since her discharge and there has been no return of her ulcer symptoms.

CASE XVIII was a man who had visited various clinics over the country during a period of five years. He had the typical ulcer symptoms, including hæmatemesis. He took the treatment one week and declined to continue any further. His gastric symptoms were completely abated while the treatment was in process. His subsequent history has been impossible to obtain.

CASE XIX was a child four and a half years old who had been sick ten weeks. He had been under the care of Dr. P. F. Barbour and Dr. Cleves Richardson. He was intensely jaundiced, very weak with temperature ranging to 107° per rectum. His urine was scant and coffee-colored, he had abdominal ascites and an enlarged liver that extended down to the crest of ilium. I was asked to operate for abscess of the liver. After

discussing his case with the attending physicians, we decided the abscess was multiple and operation contraindicated by his extremely low vitality and excessive temperature. The condition was agreed to be hopeless. Upon the very insistent urging of the attending physicians and the parents after they had been made fully aware of the purely experimental nature of the process, I consented to use venoclysis. We gave him 4,000 cubic centimetres of Ringer's Solution in thirty-six hours. The nurse phoned me in the night that the patient had suddenly swelled up all over and his eyes had swollen shut. I ordered immediate cessation of the drip. The next morning when I visited him I found him in a state of general anasarca, eyes closed and scrotum swollen until it was transparent. I was a little encouraged, however, because his urine had increased in quantity and was lighter in color. His temperature had come down to 103° rectal. From that time all his symptoms began to improve, his temperature range dropped to 99°–101°. The œdema gradually disappeared, as did also the jaundice; his liver gradually went down until when he left the hospital it was not more than two inches below the costal margin; and at the time he left the hospital he seemed entirely recovered except that his normal weight and strength had not been regained. I report this case empirically without any hypothesis to explain the results except the theory of dilution of toxins. This child is now perfectly well and normal in every respect one year after the treatment.

The nineteen cases above cited comprise a group that illustrate an application of the principles of venoclysis somewhat divergent from the original line of thought. The results indicate the wide range of its usefulness which is as yet unexplored and which offers a most inviting territory to students endowed with curious and scientific impulses. Venoclysis has served me a more useful purpose in the treatment of general peritonitis adynamic ileus than any other one remedy, allaying thirst, supplying nutrition, slowing and strengthening the heart action, quieting delirium and maintaining the action of the kidneys and reducing to a marked degree the very distressing emesis that characterizes this malady. But the mortality of this group remains very high yet. I am encouraged by the fact that now and then I am able to save a patient who, I am convinced, would otherwise have died. Especially is this true concerning late cases of intestinal obstruction.

I feel that the time is approaching when all treatment for acute toxæmias will receive both medication and nutrition in this way. I am constrained to believe that a dose of anything when applied to the blood-stream is illogical and unscientific because the entire load is imposed suddenly on the distributing and assimilating powers of the circulation, which by the sheer weight of the burden may be crushed and paralyzed into a state of helpless confusion. Hence the frequent evidences of shock as manifested by chills, fever and exhaustion.

If the same fluid be administered by venoclysis drop by drop as the heart beats it is free from intolerance, is distributed and consumed at a rate proportionate to its delivery and imposes no sudden or excessive demands upon the vital functions and fulfills the sublimest conception of "benevolent assimilation." When therapeutic agents are administered by the mouth, rectum or subcutaneous tissues, dosage is both rational and commendable because from these sources their entrance into the circulation is balanced by the process of absorption. This is a process that regulates the ratio of

supply and demand in the animal economy. This valuable stabilizer does not have the opportunity to function when substances are introduced suddenly and directly into the circulation. Hence one chief value of venoclysis is that it embodies an effort to imitate the normal operations that take place in nature's laboratory.

A summary of my clinical experiences to date in addition to the cases herein reported would include seven cases of peptic ulcer, in six cases there has been a complete arrest of symptoms and gain in weight of as much as twenty pounds in one case; two cases of septicæmia with blood-stream infection, both recovered; eleven cases of apparently hopeless pernicious vomiting of pregnancy, all recovered. One case of tularæmia in which the red blood count rose in twenty-four hours from 2,600,000 to 4,200,000 and in forty-eight hours to 4,900,000. The patient, although seventy-two years of age and had been sick three months, made a very prompt recovery. We have a series of about 100 cases of various intestinal lesions including obstruction, peritonitis and ulceration, in all of which comfort was afforded and in the majority recovery took place.

TRANSACTIONS

OF THE

PHILADELPHIA ACADEMY OF SURGERY

STATED MEETING HELD JANUARY 7, 1930

The President, Dr. Astley P. C. Ashhurst, in the Chair

Calvin M. Smyth, Jr., M.D., Recorder

ALLERGY AND ASTHMA IN POST-OPERATIVE ATELECTASIS

Dr. Walter Estell Lee and, by invitation, Dr. Harry B. Wilmer and Dr. Herbert Marshall Cobe read a paper entitled "A Report of the Incidence of Allergy and Asthma in a Group Developing Post-operative Atelectasis," for which see page 651.

Dr. Walter Estell Lee said that in the findings of allergy he was never convinced that what had been observed was the only etiological factor. Something must start the phenomenon of post-operative atelectasis and why 20 per cent. of these cases developed this was hard to explain. Two of these cases which had been presented proved that not only allergy but other factors are necessary. First the case spoken of as number three. This man had a right-sided herniorrhaphy. There was a definite history of asthma and he developed on the second day atelectasis on the right side. A year later, he came into the hospital and had herniorrhaphy on the left side and developed a massive atelectasis on the left side. This man has asthma, the result of pain and posture and he has one of the factors necessary. Another boy was operated on for appendicitis. He developed massive atelectasis but the interesting thing is that, although the boy is still allergic, eighteen months later he had a mastoid operation and nothing happened. As a matter of fact there are no recorded cases of post-operative atelectasis following herniorrhaphy on one side while the second one developed atelectasis following abdominal operation.

OXYCEPHALIA

Doctor Thomas A. Shallow presented an infant, aged four and a half months, male, white, who was admitted to the Jefferson Hospital, in the service of Dr. J. Chalmers DaCosta, with a history of having generalized convulsions.

The child had been delivered as a breech presentation after a very difficult labor. After birth he was not cyanotic nor was there any other symptom which led the physician in attendance to suspect the presence of birth hæmorrhage. The mother stated the child did not seem to be as observant as other children of his age. He was fed from the breast up to his admission to the hospital.

Suddenly, November 13, 1929, one week before his admission to the hospital, he had a generalized convulsion, involving both extremities—the attack lasted ten minutes. The same evening he had a similar attack which lasted twenty minutes. The following

day he had two attacks which were more aggravated than those of the first day. The mother states positively that the child did not observe objects as well as he had before the attacks. She was very apprehensive about his vision.

The family history was negative. The patient is a well-nourished male infant, not dyspnœic nor cyanotic. The head is larger than normal in the vertical diameter. The fontanelles are wide open. The parietal bones are prominent. The eyes are fixed and staring; there is fairly good rotation but there is impairment of convergence. Eye-ground examination of the right eye: media clear, disc pale, central margin clearly defined. Left eye: similar. These conditions indicate the presence of primary optic atrophy of both eyes; paralysis of convergence.

The nasal passages and nasal septum are normal; the alveolar processes are normal; the hard palate is much higher than normal. The pharynx is normal. The chest and abdominal examination discloses no evidence of thoracic or intra-abdominal pathology. There is no deformity or muscular weakness of the extremities present. The reflexes are normal. Kernig's sign is negative.

Several diagnoses were considered: 1, hydrocephalus; 2, hæmorrhage of the new born; 3, tumor of the brain, based on (*a*) the history of convulsions; (*b*) the enlarged head; (*c*) the primary optic atrophy.

Studies for the diagnosis of hydrocephalus.—A lumbar puncture was done; the fluid was normal in appearance and was not under pressure. A needle was introduced into each lateral ventricle through the anterior fontanelle. On the right side the needle entered the lateral ventricle three centimetres from the scalp; the fluid was under moderate pressure, fifty-five cubic centimetres were removed. On the left side the needle entered the left lateral ventricle five centimetres from the scalp. The fluid pressure was decidedly greater on this side and seventy-three cubic centimetres of spinal fluid were removed from the ventricle. Air was introduced into each lateral ventricle corresponding to the amount of fluid removed, that is, fifty-five cubic centimetres of air were introduced into the right ventricle and seventy-three cubic centimetres of air were placed in the left lateral ventricle.

Comment.—It was thought, because of the distance traversed by the needle to reach the lateral ventricles, the child did not have a marked hydrocephalus. It was also noted that the level of the roof of each ventricle and the capacity of the ventricles varied.

Doctor Manges reported that the X-ray shows a head much higher than the normal; the sella tursica is small, the sutures at the base of the skull seem to be united. There is complete absence of convolution depressions on the entire table of the skull. Possibly it is too early to expect convolution depressions to appear, but the impression is that the brain is not in contact with the skull.

Figure 1 shows the location of both ventricles, the left ventricle on the lower plane than the right. Both lateral ventricles, while slightly enlarged, are not hydrocephalic. The third ventricle is many times larger than normal. The report of the X-ray examination furnished the added information that this child had a much higher head than normal, associated with fusion of the basal sutures. Its failure to demonstrate lateral ventricular hydrocephalus led to the consideration of a fourth possibility—*oxycephalia*, that interesting deformity which is called by some "tower head," by others "turmschädel," which is caused by early fusion of some of the sutures of the skull, preventing the normal expansion of the brain.

The etiology of turmschädel or tower skull is disputed. It is claimed by some that traumatism at birth is a factor in the production of synostosis of the sutures. It is claimed by others that rickets is the etiologic factor in its production. There seems to be no question in this case but that the child had been delivered after difficult breech labor. The long bones were X-rayed and Doctor Manges reported evidence of rickets in some of them.

On December 22, a number of weeks after admission to the hospital, the patient had a return of the convulsions with repeated general spasms of the flexion type involv-

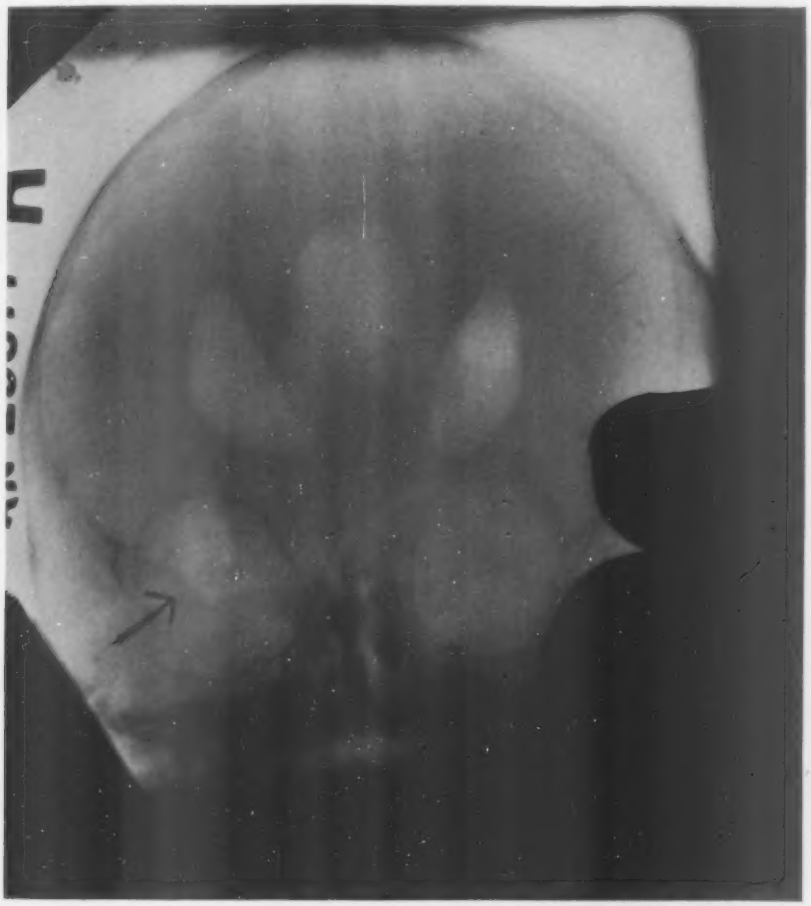

FIG. 1.—Showing the position of both lateral ventricles and a greatly distended third ventricle. Showing over the right eye a collection of air in the basal cistern at the point of penetration of the base of the skull.

ing both extremities. The child was not unconscious but had between forty and fifty spasms within three hours. The seizures appeared to be the typical tetanic flexion spasms of the hands and feet seen in rickets—eliminating the possible diagnosis of birth hæmorrhage, which was made on the history of convulsions before the patient was admitted to the hospital. A spinal tap was done and the tetanic spasms subsided within twenty minutes. The reason for this was not clear.

The laboratory examinations failed to reveal anything of an unusual nature except a slight lymphocytosis.

On the basis of the above oxycephalia was the presumptive diagnosis, but the possibility of brain tumor had to be considered. If there were a brain tumor present, causing obstruction of the aqueduct, choked disc would have been noted, not primary optic atrophy; lateral ventricular hydrocephalus would have dominated over third ventricular hydrocephalus.

An encephalogram was done to determine the extent of the obstruction of the aqueduct. Only fifty-five cubic centimetres of spinal fluid could be obtained by spinal tap.

FIG. 2.—Showing the high head of Oxycephalia. The position of the floor of the skull with the anterior and middle fossæ almost on the same plane. At the arrow point showing the protrusion through the base of the skull into the pharynx representing the position of the collection of air in the region of the right orbit in Fig. 1.

An equal amount of air was introduced. The X-ray picture showed some air in each lateral ventricle; most of the air was collected in the basal cisterna. Figure 2 shows a bulging into the pharynx from the floor of the skull. This finding is in accord with the observation of Towne (*A. J. M. S.*, 1928). In one of his reported cases the brain herniated into the nose; in another of his cases there was an erosion of the base of the skull. The reporter remarked that because of the peculiar conformation of the floor of the skull in oxycephalia there is mechanical obstruction at the aqueduct. In this case the ventricles are not on the same plane (Fig. 1). The drainage from the basal cisterna is

impeded, the basal cisternæ are distended, eroding the floor of the skull, making pressure on the optic tract and producing primary optic atrophy.

This case seems to confirm the belief that rachitis is the etiological factor in the production of the oxycephalia, because of the tetanic spasms and the presence of the X-ray manifestation of rachitis in the long bones.

Dr. Francis C. Grant said that from the history of the patient and from an examination of the X-ray plates, he rather felt that this was unquestionably a case of oxycephalia. He believed that brain tumor may be excluded inasmuch as the child had a bilateral optic atrophy. The convulsions or spasms from which the child suffered, he believed, could be attributed to rickets. With regard to the ventriculographic pictures which Doctor Shallow obtained, it seems probable that the reason for the inequality may well be that all of the fluid is not removed from the ventricles which therefore are not completely filled with air. The fact that he was able to remove 128 cubic centimetres of fluid from both ventricles combined makes it obvious that the child has an internal hydrocephalus. This is confirmed by the enlargement of the third ventricle which usually occurs in this condition. With regard to the etiology of the cranial condition, Doctor Grant said that a tower skull is commonly produced by premature union of the sutures at the base of the brain. This prevents the floor of the skull from growing at the same rate as the vault; crowds together the structures at the base and may account for the optic atrophy here seen, by stretching the optic nerves within their foramina and expansion of the hydrocephalus by interference with the circulation of the cerebrospinal fluid through its channels on the base of the brain. With regard to treatment, it is not certain that we can do much after the suture lines at the base have become prematurely ossified. He has seen two cases in which the sutures of the vault became prematurely ossified which were relieved, temporarily at least, by linear craniectomy along the line of the sutures. The mechanical opening of the suture line permitted the normal expansion of the brain and relieved compression. He is extremely doubtful, however, whether this procedure is indicated in this particular case.

Dr. Benjamin Lipshutz said that in the interpretation of this ventriculogram the possibility of a large cavity of septum pellucidum suggests itself. The septum pellucidum is usually present as a thin, vertically placed partition which separates the anterior part of the two lateral ventricles from each other. It consists normally of two lamina enclosing a narrow median cavity known as the fifth ventricle (cavum septi pellucidi). Morphologically and embryologically it has no direct relation to the lateral ventricles. In approximately one in two hundred brains observed in neuro-anatomical laboratories of Jefferson Medical College, a very large cavity of septum pellucidum is encountered.

As the cavity of septum pellucidum enlarges, it causes an attenuation a thinning of its lateral walls, and in three instances an actual dehiscence effected, thus establishing a direct communication between the cavi septum pellucidum and the lateral ventricles. The enlargement of the

of septum pellucidum may take place at expense of lateral ventricles. The position of this shadow is directly in median line and is in same plane as the lateral ventricles. In those instances where the cavity of septum pellucidum was very large, the roof of the third ventricle is greatly depressed.

OBSTETRICAL PARALYSIS

Dr. Paul N. Jepson, by invitation, read a paper with the above title for which see page 724.

Dr. A. Bruce Gill remarked that for the past several years he had had occasion to do a good deal of work in the anthracite coal region, and has found the condition quite prevalent there. The slighter cases recover function and all that is required in them is to prevent deformity. One does that by putting the arm in the position Doctor Jepson had described. After the deformity has become a permanent one, possibly it is best to do osteotomy accompanied by tenotomy. As regards operations upon the brachial plexus, there is considerable difference of opinion. There are few men who practise this routinely and the results rarely justify it.

Dr. Astley P. C. Ashhurst said that some years ago when the controversy between Dr. T. Turner Thomas and the proponents of the neurogenic theory was at its height, he was invited to accompany Doctor Thomas to a neighboring city to see one of these brachial plexus operations. They saw it done and Doctor Ashhurst remarked that if anything could be more barbarous, he had never seen it. He later learned that the result was unfavorable but the surgeon at the same time referred to many cases in which the procedure had been highly successful.

Dr. Thomas A. Shallow said that he does not think the operation upon the brachial plexus is a serious or difficult one and believes the results in adults are extremely satisfactory. He added that he had eight cases to show which have almost complete return of function.

MORTALITY FROM APPENDICITIS

Dr. Thomas J. Ryan, by invitation, read a paper with the above title for which see page 714.

Dr. John O. Bower, by invitation, said that surgeons are most interested naturally in their own mortality. To this end the patients that come directly under the supervision of the individual are given the best he can give. He wished for a moment to speak of the importance of hospital mortality. The mass mortality of the hospital—how many go in with appendices and how many go out—this is important because hospitals as well as individuals have reputations. The figures he wished to give represent the analysis of over a thousand clinical records of patients who had appendicitis. All but a few were operated upon. The analysis of the charts was made by one person assisted by another. The following is a brief summary of the findings:

The factors that influence mortality in appendicitis can be divided into two periods—before and after the patient enters the hospital.

The two factors influencing mortality before the patients enter the hospital are delay and laxatives. At one hospital, where 750 patients were oper-

ated upon, the average time between onset of appendicitis and operation of those who lived was 69 hours; for those who died 151. At another hospital where 252 clinical records were analyzed the average time between onset of appendicitis and operation of those who lived was 90.4 and those who died 157.7 hours; of the 750, 45 per cent. had perforated; of the 252, 46.8 per cent. of the 750, 337 had perforated and 310 or 92.3 per cent. had been given laxatives; of the 252, 118 had perforated and 103 or 87.2 per cent. had been given laxatives; 21 per cent. of the 45 per cent. were cases of general peritonitis. Of the one thousand cases there were 87 deaths—70 per cent. of these had general peritonitis; 93 per cent. or 65 of these had been given laxatives before entering the hospital. Now this is not the surgeon's problem, this is a problem that demands publicity.

In Philadelphia, fortunately, a campaign, sponsored by the Philadelphia County Medical Society, the Department of Public Health and the Philadelphia Association of Retail Druggists, has been instituted to combat this abuse.

The problem that belongs to the surgeon is the problem of the management of general peritonitis. General peritonitis is still responsible for about 78 per cent. of our mortality and the mortality of general peritonitis still varies from 15 to 40 per cent. depending on who operated and when and how. An accurate analysis of the charts of the two hospitals shows that the greatest mortality was at the hands of surgeons who operated immediately on all cases, who did not strictly Ochsnerize his patients post-operatively, who removed appendices in the presence of a spreading peritonitis and who practised the early removal of drains.

Dr. Edward Crossan said that a great deal depends on the attitude of the surgeon in cases of acute appendicitis; while not wishing to minimize the importance of education of the public regarding the danger of the indiscriminate use of cathartics in abdominal pain, he thought that there was something to be said regarding the education of the surgeon. For example, it is a too common practice for some surgeons to allow a case of acute appendicitis to "ride" until it is convenient for the surgeon to operate. This practice is to be condemned. He believes also that there is a tendency on the part of some to rely on drainage alone, leaving the appendix behind. Of course this is sometimes necessary but not as a rule. He attributed the low mortality, 3.5 per cent., in Doctor Ashhurst's service to prompt and adequate surgery. He also wished to ask Doctor Ryan how many cases in his series were not operated upon because he felt they were too sick for any sort of operation.

Dr. Hubley R. Owen said that he believed strongly in the necessity for education of the public rather than of the surgeon. In the Philadelphia General Hospital, Doctor Owen's statistics showed a lower mortality than those of any of his colleagues. This was not to be interpreted as meaning that he operated more skillfully but was due to the fact that nearly all of his patients were police or firemen and that these men had been repeatedly cautioned against and were well aware of the danger of taking castor oil, salts and other cathartics for the relief of abdominal pain. When a policeman

or fireman was reported as sick with abdominal pain, a member of the staff was at once sent to see him and if he was found to have appendicitis, he was promptly hospitalized and operated upon.

The speaker also called attention to the pernicious practice of retail druggists' prescribing over the counter for abdominal pain. Such prescriptions were almost invariably for castor oil or citrate of magnesia and many an appendix had perforated as a result of this sort of thing. When Doctor Owen took the matter up with the president of the Philadelphia Retail Druggists' Association, and his remarks were quoted in a pharmaceutical journal he was severely criticized by many druggists who regarded this as an invasion of one of their prerogatives. The speaker added, however, that the Philadelphia druggists had shown every desire to coöperate in the matter.

Dr. Astley P. C. Ashhurst reported his recent individual experience with operations for complicated cases of appendicitis (as a sequel to the Table published in the Annals of Surgery, 1927, vol. lxxxv, p. 89):

The only death occurred in a man, forty-five years of age, who was operated on May 25, 1929, the day of admission, for a primary appendicular abscess. Ten days later (June 4, 1929) he was re-operated on for continuing subacute intestinal obstruction, unrelieved by non-operative treatment. He was much improved by this second operation for three days (until June 7, 1929). On June eighth he seemed moribund, and Doctor Ashhurst thought it hopeless to attempt another operation. However, Doctor Crossan was more optimistic, and with Doctor Ashhurst's approval, reopened the abdomen, but found so many kinks involving the entire small bowel, without any strangulation or acute kinking, that nothing could be done; and death occurred about seven hours after this, the third, operation. Both this and the second operation were done under spinal anæsthesia.

Among this recent short series of twenty-eight cases, there were some very ill patients: a *fæcal fistula* developed in the wound in four cases; in all it closed spontaneously in a few days, and all the patients recovered. In fact, this service has come to recognize a fæcal fistula as a favorable event in very sick patients, but has not yet attempted a formal cæcostomy at the time of the primary operation.

One case of *gastric tetany* was encountered in this series: A man forty-one years of age was admitted August 23, 1926, suffering for eight days before admission with his second attack of appendicitis. An abscess was drained and the appendix removed on the day of admission. The night following the operation the ward surgeon administered a hypodermic injection of *eserine*, for tympany. This caused in a few hours symptoms of intestinal obstruction, which were relieved by lavage of the stomach and morphine. In a few days the patient developed severe diarrhœa. Eight days after operation he developed acute dilatation of the stomach, with tetany. This was relieved by gastric lavage, hypertonic (15 per cent.) sodium chloride solution intravenously, and an inlying duodenal tube, which was in place for thirty-six hours. After this, recovery was uneventful.

Doctor Ashhurst remarked that eserine had been given to this patient

without his knowledge or approval; he regarded it as a dangerous remedy except for simple atonic dilatation of the intestines. In post-operative cases where there may be peritoneal adhesions, he thinks eserine peculiarly dangerous: it rouses so much peristalsis that obstruction scarcely can be avoided. Doctor Ashhurst reminded the Fellows of the Academy of the previous report from his service of a case of gastric tetany, by Dr. Henri De Bayle, now of Nicaragua (ANNALS OF SURGERY, 1925, vol. lxxxi, pp. 622-630).

A third case of special interest was that of a man thirty-one years of age, who had an *incarcerated right inguinal hernia*, complicated by an *appendicular abscess* in the recto-vesical pouch.

Doctor Ashhurst added that it did not seem fair to publish, without qualification, what may be regarded as a selected series of complicated cases of appendicitis, because, as noted in the previous report (1926) on the mortality of appendicitis, he does not himself do most of the emergency operations. He has, therefore, tabulated, below, all the complicated cases of appendicitis admitted to his service (1926-1929), in which the operations have been done by other members of his staff: Doctor Boykin, Doctor Crossan, Doctor Klopp, and in some cases by the Chief Resident Physician for the time being. He desired it to be understood that this larger series is more truly representative of the service of a large hospital, than is his own smaller series. For instance, if the three patients, who were so ill on admission as to make operation not justifiable, were transferred to Doctor Ashhurst's individual list, the general mortality in that series would be above 14 per cent. Yet when these three patients were seen the day after admission by himself, postponement of the operation had been approved by him.

TABLE I

Operations for complicated cases of appendicitis

(October 1, 1926 to January 1, 1930)

(Doctor Ashhurst's individual operations)

	Cases	Operations	Deaths	Mortality
Operation on Admission				
Primary Abscess	12	12	1	8.5%
Gangrene	9	9	0	...
Diffuse Peritonitis	6	6	0	...
Total	27	27	1	3.7%
Delayed Operation				
Died without operation	0	0	0	...
Abscess drained, appendix not removed	0	0	0	...
Abscess drained and appendix removed	1	1	0	...
Total	1	1	0	...
Grand Total	28	28	1	3.5%

TABLE II

Operations for complicated cases of appendicitis by Doctor Ashhurst's staff, at the Episcopal Hospital

(October 1, 1926 to January 1, 1930)

	Cases	Operations	Deaths	Mortality
Operation on Admission				
Primary Abscess	19	19	0	...
Gangrene	14	14	2	14 %
Diffuse Peritonitis	26	26	4	15 %
Total	59	59	6	10 %
Delayed Operation				
Died without operation	3	0	3	100 %
Abscess drained, appendix not removed	2	2	2	100 %
Abscess drained and appendix removed	0	0	0	...
Total	5	2	5	100 %
Grand Total	64	61	11	17 %

TABLE III

All operations for complicated cases of appendicitis in Doctor Ashhurst's service at the Episcopal Hospital

(October 1, 1926 to January 1, 1930)

	Cases	Operations	Deaths	Mortality
Operation on Admission				
Primary Abscess	31	31	1	3.2%
Gangrene	23	23	2	8.7%
Diffuse Peritonitis	32	32	4	12 %
Total	86	86	7	8.1%
Delayed Operation				
Died without operation	3	0	3	100 %
Abscess drained, appendix not removed	2	2	2	100 %
Abscess drained and appendix removed	1	1	0	...
Total	6	3	5	83 %
Grand Total	92	89	12	13 %

DR. THOMAS RYAN said that he regretted that the immediate mortality had been made a matter of discussion. It was not his intention to go into this phase of the question at all. With Doctor Ashhurst, he agrees that it is not of any importance except in the cases requiring drainage. The point that he wished to make was that mortality from appendicitis is on a continuous and progressive increase. In 1895 with a mortality of 20 per cent., fewer people died from the disease than in 1922 with a mortality of 13 per cent. None of the speaker's cases died without operation.

TRANSACTIONS

OF THE

NEW YORK SURGICAL SOCIETY

STATED MEETING HELD FEBRUARY 26, 1930

The President, Dr. Edwin Beer, in the Chair

SPLENECTOMY FOR MYCOTIC SPLENOMEGALY

Dr. Paul A. Dineen presented a man, thirty years of age, who entered the hospital July 3, 1929, and was discharged September 7, 1929. At the time of admission he complained of hæmorrhages from the mouth and rectum, swelling of the abdomen and swelling of the feet. The present illness began four and one-half years prior to admission, when the patient suddenly vomited about two quarts of bright red blood. He was otherwise asymptomatic. He was taken to a hospital and stayed there five weeks. There was no more hæmatemesis but he did pass blood by the rectum. Received three transfusions and was discharged much improved. He returned for a blood count in one month and was found to be again anæmic, but was otherwise asymptomatic. Remained one week and received one transfusion. There was no recurrence of bleeding. He then received iron by hypodermic every week for three months. During second admission an enlarged spleen was found. Splenectomy was advised at a later date. Each time he went to the doctor at intervals for a splenectomy he was told that his condition was not good enough to warrant operation. He remained asymptomatic until five weeks ago when he suddenly developed another hæmatemesis and was taken to the hospital. His vomiting ceased shortly after admission and his stools, which were tarry, cleared in three days. He was transfused. One week after admission, he had another hæmatemesis. He was discharged three weeks after admission and other than weakness, was asymptomatic. Patient thought his abdomen had become distended during his stay in the hospital. Before the distention occurred, he was able to feel his spleen. There was also some œdema of the left scrotum and both ankles.

At the time of admission he was a pallid, anæmic-looking man with a large, swollen abdomen. Conjunctivæ were very pale. The tongue was slightly furred. The left lower thorax was bulging and the left costal margin was restrained. There was increased precordial activity. Left border of cardiac dulness was at the anterior axillary line. Right border of cardiac dulness was one centimetre beyond the right sternal border. There was a soft systolic murmur and a split second sound. The lungs were normal. The abdomen was distended markedly with a definite fluid wave. The spleen was greatly enlarged, extending to the left rectus border and to the pelvic brim. The liver was not palpated clinically. The impression at this time was that the patient presented a history and picture of Banti's disease with a marked secondary anæmia and cloudy swelling of the myocardium with hæmic murmurs.

His laboratory findings at this time were:

	7/3/29	7/10/29	7/15/29	7/17/29	7/19/29
Red Blood Cells	2,760,000	4,470,000	3,640,000	4,000,000	4,000,000
Hæmoglobin	45%	65%	65%		
Color Index	.8				
White Cells	3,600	9,900	4,300		
Polymorphonuclears	66%	60%	60%		
Lymphocytes	22%	40%	40%		
Large Mononuclears	6%				
Transitionals	6%				

A smear of the blood showed small pale red blood corpuscles with moderate anisocytosis. No poikilocytosis. No malaria parasites. Bleeding time and clotting time were normal. Urine was negative. No blood in stools. Small increased fragility of the blood cells. Blood sugar 109. Blood urea 6 milligrams per 100 cubic centimetres. Wassermann negative.

He was transfused and on July 20 a splenectomy was performed under spinal anæsthesia, supplemented with ethylene. A combined vertical and transverse incision was used. At operation a large, firm spleen was encountered. It was impossible to deliver it into the wound on account of adhesions. The liver was small and nodular, presenting a picture of a typical cirrhosis. Moderate amount of ascitic fluid. The spleen had firm adhesions posteriorly which were difficult to divide. It was possible to deliver the spleen following division of these adhesions. There was a certain amount of oozing along the diaphragm and clamps and packing were applied to this area. The patient was transfused immediately following operation. Six hundred cubic centimetres of blood were given. The day following operation red count was 4,220,000. White cells were 27,000 with 86 per cent. polymorphonuclears. July 22 the red cells were 3,470,000; hæmoglobin 70 per cent. Smear count of white cells was 25,300 with 94 per cent.; large mononuclears 2 per cent.; transitionals 2 per cent.

Prior to operation the man ran a normal temperature for sixteen days. After the operation his temperature slowly increased during next twenty-four hours to 103.2°. It then dropped on the second post-operative day to 100° to 101° and continued along with a gradual rise at times to 103°. During this period the patient had several acute blood crises, the last of which occurred August 21, when his count went down to 1,800,000. He was given a transfusion of 750 cubic centimetres of blood. He had been given one previously August 19, also of 750 cubic centimetres, and it look as though nothing could control the process of blood destruction. At this time it was decided to try neosalvarsan in doses of 45/100 gram because of the presence of a mycelium of fungus found in the spleen and in spite of the fact that the patient had a cirrhosis of the liver. The first dose of neosalvarsan was given August 23. Within thirty-six hours the temperature subsided to normal from 100° and was normal for the remainder of the stay in the hospital. His red counts showed a very gradual but continued rise.

Pathological Report (Preliminary).—The specimen consists of a spleen weighing 825 grams and 20 by 11 by 3 centimetres in size in the partially fixed state. The capsule seems to have been thick with some small elevated spots on it. The organ is fairly tense. On section it appears meaty. Fairly firm small yellow masses are found scattered through it, and trabeculæ which are fairly prominent run through it. The rest of the tissue is firm, but spongy. In the basin is also found a blood clot covered on one side by a thin membrane.

Microscopically the malpighian bodies are small. The endothelial cells of the pulp

are increased in number and many polynuclears are present. The nature of the greenish-yellow masses is not apparent as yet.

(Subsequent) Splenomegaly, splenic fibrosis. Fungus-like inclusion bodies.—The spleen shows small compact malpighian bodies. The sinuses are rather large and contain many red cells. There seems to be an increase in fibrous tissue between the sinuses. The greenish-yellow masses are made up of jointed strands of yellowish material thought to be mycelium of fungi. The mycelium-like material stains for iron, the tissue just around it even more strongly.

The man has been followed on the outside, coming in for his neosalvarsan injections, at which times he had blood counts. His blood count gradually rose until on October 4 it was 4,600,000 with hæmoglobin of 90 per cent. The most recent count is over 5,200,000 on February 21. He has been at work, feels well and has gained eighteen pounds. He is entirely asymptomatic and feels very strong. It is interesting to note also that subjectively the patient prior to his first neosalvarsan injection felt, as he expressed it, "tired and pepless" and likewise within thirty-six hours after his first injection in conjunction with his temperature decline and a beginning improvement of his red cells, he stated voluntarily that his feeling of tiredness had completely disappeared.

An article by R. H. Jaffé and L. R. Hill in the *Transactions of the Chicago Pathological Society* (vol. xiii, pp. 35-49) for June, 1928, on "Splenic Mycosis," discourses at length on mycotic diseases of the spleen. The literature is well thumbed and the pathology reviewed in detail.

These large spleens were noted in Algerians and later in Frenchman and a definite splenomegaly, mycotic in character, was demonstrated. The picture is not unlike that of Banti's disease. The rapid and continued recovery in this case after the salvarsan has been very remarkable.

In the article by Jaffé and Hill it was stated that mycosis of the spleen is not uncommon among Algerians and it had been thought that the condition was peculiar to these people. It has been found, however, that there are many cases among the French. The speaker believed them to be more common than had previously been realized. There were technical difficulties in connection with the staining of the specimen that have recently been overcome and a correct diagnosis can now be made more readily. This is probably the reason that there appear to be more.

Dr. Lawrence W. Smith (by invitation) said that the pathology in this case was quite unusual. During the past year or so several papers have appeared on the general subject of splenic mycosis, atypical foreign body reactions, etc., etc. This particular case seems to have all the evidence at hand to prove its identity, without the necessity of the pathologist, with the cultivation of the organism by the bacteriologist and the clinical cure following arsphenamine therapy. The Pathological Department of the New York Hospital, however, was able to demonstrate the presence of these mycelial-like structures in the fibrous stroma of the spleen to confirm the story. The reaction appeared to be of a foreign body with the precipitation of a brownish pigment of a ferruginous character. This became deposited on the mycelial strands and on the regional degenerated collagen and elastic tissue fibres as well. It appeared to be composed of iron phosphate, for the

most part, from all the available information at hand. This case is one of a group about which very little is known and one in which a great deal of investigative work should be done.

PAROTID GLAND ADENO-CARCINOMA IN ABERRANT THYROID TISSUE

Dr. Seward Erdman presented this case because of the unusual histology of the tumor removed from the right parotid gland, and the question as to the origin of the cells. The patient, a man aged forty years, was admitted to the Second Surgical Division of the New York Hospital October 2, 1929, and discharged October 11 on account of a tumor of the right parotid gland which was firm in consistency, deeply fixed, non-tender and with no apparent involvement of nerves, nor skin attachment. He had first noted swelling of the gland two and one-half years ago. Since that time there has been gradual painless enlargement until it is now the size of a large lemon. In cold weather he experiences a dull ache in the auditory canal and throughout the swelling.

Operation.—General physical examination negative. Wassermann test negative. At operation, upon exposing the surface of the parotid, no abnormal tissue was seen. After incising the parotid to the depth of one-half inch, there was encountered the glistening, gray surface of a large, sharply demarcated tumor, which seemed to have replaced parotid tissue and which extended by irregular lobulations deep into the maxillary region, passing well behind and onto the mesial aspect of the ascending ramus of the jaw. The internal maxillary artery was thus exposed. The facial nerve was so intimately involved in the growth that it was impossible to avoid injury to it.

The tissue was gristly in consistency, nodular, with a diffuse stroma of dense connective tissue, and was yellowish-white in color.

Microscopic Examination (by Dr. Lawrence W. Smith)—Demonstrated an extremely cellular adenocarcinoma, with numerous mitoses. In places definite lumina are found filled with colloid-like material. The cells and the architecture very closely approximate thyroid tissue. The stroma is pseudo-cartilaginous. The tumor is definitely malignant, but is atypical of the usual parotid tumor and might have its origin either in the parotid or in thyroid.

It is now only four and one-half months since operation, but up to the present there is no evidence of recurrence. If the facial paralysis remains too deforming, the use of a fascial strip to raise the drooping angle of the mouth might be considered, at some later date.

Dr. Lawrence W. Smith (by invitation) stated that this case presented a very difficult differential diagnostic problem in the laboratory. As has been noted from the clinical history the case did not appear to be quite the usual parotid mixed tumor as it was covered by fairly normal glandular tissue. The material for study consisted of about 5 cubic centimetres of gristly, nodular fragments from the tumor. Grossly, these were not characteristic. The microscopic appearance of the tumor, likewise, was very unusual. As can be seen from the microphotograph (Fig. 1) the cells are relatively low cuboidal in form and arranged in acini of varying size. Many of these are distended and filled with hæmogenous eosin-staining colloid-like material suggesting thyroid tissue. In other areas little secretory activity is noted,

with the acini small and empty. Embedded in the stroma are scattered islands of acinar tissue, which again duplicate the histological picture of thyroid.

These slides have been submitted to several pathologists who concur in the opinion that the microscopic picture is indistinguishable from that of thyroid tissue. Whether it is actually thyroid, or some extremely atypical alveolar development with retention of parotid secretion it is impossible to state positively. Doctor Smith was distinctly of the opinion, however, that this was an aberrant thyroid tumor, although it lacks the usual papillary tendency which aberrant thyroid tissue shows.

FIG. 1.—Tumor of Parotid (Aberrant thyroid tissue).

Embryologically, it is difficult to explain its possible thyroid relationship. As is well known, the thyroid arises from two anlages, one, the mid-line and principal source of tissue, from the base of the tongue, descending by way of the thyroglossal duct to its final position; the other from the out-pocketing of the posterior portion of the pharynx—the ultimo-branchial body—and migrating laterally and downward to fuse with the lateral lobes of the gland. Accordingly, the usual location of aberrant thyroid tissue is along this migratory tract in the neck and should not reach above the angle of the jaw; but one finds so many anomalous structures in the head region that it seems best to classify this case on the basis of its histology.

CYST OF STOMACH WALL (ABERRANT PANCREATIC TISSUE?)

DR. SEWARD ERDMAN presented a woman, nineteen years of age, who in general has enjoyed good health without serious illnesses and no operations except a tonsillectomy in childhood. She has always had some degree of dysmenorrhœa at the menstrual periods.

For the past year, she has had attacks of pain in the right side of the abdomen, usually lasting only a few minutes, and not definitely related to meals, although several times the pain has come on about twenty minutes after her evening meal, and on some occasions she has experienced nausea but has never vomited. The pain at times radiates toward the navel, or at times spreads downward to the pubic region and the right thigh. It is relieved by lying down; following the pain she usually feels nauseated.

Early in January, 1930, she was admitted to the Second Surgical Division of the New York Hospital for observation, which included a gastro-intestinal X-ray series. There was no suggestion of kidney pathology either from the urine examinations nor from the X-rays; nor was there any sugar in the

FIG. 2.—Cyst of stomach wall. X-ray shows filling defect at pylorus.

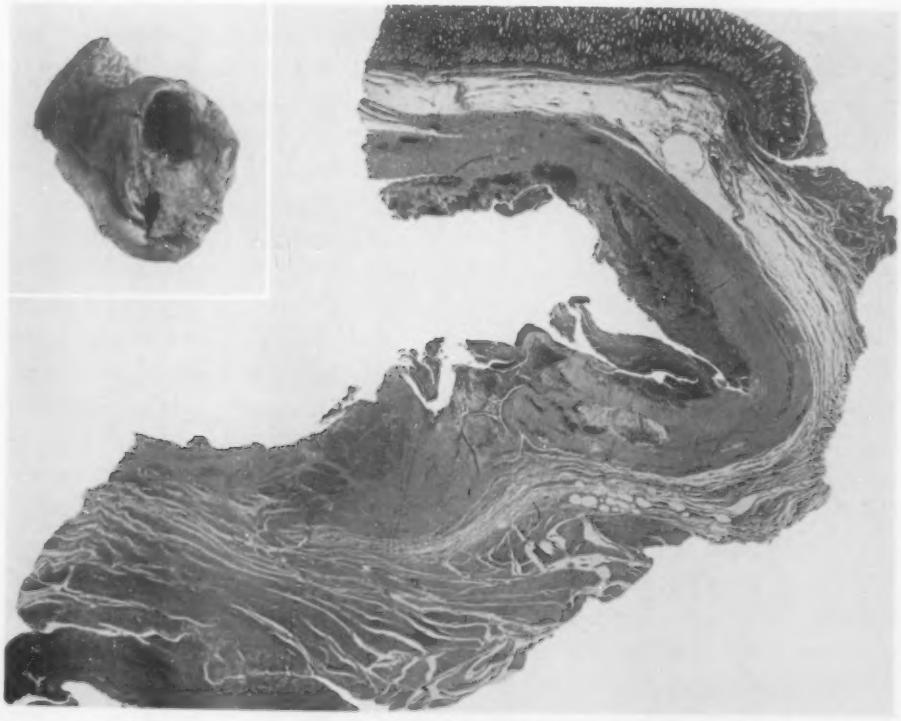

FIG. 3.—Cyst of stomach wall. (Above) Gross specimen. (Below) Microphotograph of cyst.

urine, and the blood sugar was normal. There was no definite abnormality on physical examination, except for slight deep tenderness over the appendix.

The X-ray films of the stomach (Fig. 2) show a definite persistent filling defect on the greater curvature side of the pyloric segment with some suggestion of finger-printing such as is seen in carcinoma, but the absence of corroborative symptoms and the youth of the patient make this diagnosis unlikely. However the picture is that of a tumor of the stomach.

Operation.—January 9, 1930, the abdomen was opened through a right rectus incision opposite the umbilicus. The pelvic organs were found normal; the appendix presented no gross lesion or adhesions but was removed.

Palpation and exposure of the stomach revealed a rounded tumor occupying the anterior aspect of the antrum pylori, near the greater curvatures. It was of tense, elastic consistency, smooth, oval outline and the serosa was not adherent over it. It extended to within 2 centimetres of pylorus.

An elliptical vertical incision was made surrounding the prominence of the mass and deepened to the blue wall of the cyst. An attempt to enucleate it did not meet with success and the cyst was penetrated, giving exit to about 40 cubic centimetres of clear watery fluid, and a quantity of brownish gelatinous material. The incision was now carried through the entire thickness of the anterior wall of the stomach, revealing a normal mucous membrane opposite the cyst. The mass was removed, including serosa and mucosa overlying it. The elliptic opening in the stomach was then sutured and the operation completed. The post-operative course was without complication.

Dr. Lawrence W. Smith said that this is a distinctly unusual lesion and one which it is difficult to identify positively. It is unquestionably a tumor of embryologic type, which simplifies the problem to some extent, for the recognized tumors of this category in this location are comparatively few in number. The specimen is best described by pointing out its important anatomical structures and relationships by means of photographs. As the specimen was received in the laboratory it consisted of a cystic tumor embedded in the wall of the pyloric end of the stomach. It had been opened and its contents were said to be watery in character. It measured, in its collapsed condition, approximately 2 centimetres in diameter and was roughly spherical in outline. Over the inner aspect of this cystic mass could be seen the gastric mucosa which appeared uninvolved in the process and to be normal in appearance. This is easily seen in the low-power microphotograph. Beneath the plica muscularis is found the wall of the cyst; it is composed of dense connective tissue which merges indefinitely with the somewhat thinned muscular wall of the stomach. The wall of the tumor contains numerous islands of epithelial-like cells which, in places, assume a definite adenomatoid arrangement. In other areas the cells are arranged in irregular masses and stain more intensely. The adenomatoid areas are strongly reminiscent of pancreas, and the feeling of the five or six pathologists, to whom the slides have been submitted, is that the tumor presumably represents aberrant pancreatic tissue which has undergone cystic degeneration. No evidence of extension into the surrounding structure is noted and only rare mitotic figures can be discerned. There is considerable round-cell infiltration in the structure

about the cystic mass. The diagnosis, as finally agreed upon, was an embryological cyst of the stomach of aberrant pancreatic origin.

The differential diagnosis in this case was from an enterogenous cyst, a malignant epithelial tumor, or a teratoid tumor, in addition to its probable pancreatic origin. Aberrant pancreatic tissue is recorded in all the text-books of pathology as being occasionally encountered anywhere along the gastro-intestinal tract, but usually within about six inches above or below the ampulla of Vater. No figures seem to be available for its incidence. The stomach is a much less frequent site, however, for its location and when occurring there is often associated with cystic degeneration. Such aberrant pancreatic tissue rarely contains islands or ducts and accordingly some degree of distention of the acini is not unusual.

Dr. Charles E. Farr said he had been present when Doctor Erdman operated on this case. At the time, he believed it to be a carcinoma and did not learn until later that it was aberrant pancreatic tissue. In the summer of 1929 he had himself operated upon a young man, about thirty-five years of age, for ulcer of the duodenum and had found a supernumerary pancreas in the upper portion of the jejunum. The duodenal ulcer demanded a posterior gastro-enterostomy but the pancreatic mass, which was about one inch long by three-quarters of an inch wide and one-sixteenth of an inch in thickness, made the short-loop operation impossible. The terminal portion of the duodenum and the upper portion of the jejunum were freed with great care from the fossa of Treitz, thus permitting the resection of the pancreatic tissue. The opening in the intestine was used to perform the usual posterior short-loop gastro-enterostomy. The patient made an uninterrupted recovery and has remained well since.

At the time of operation this pancreatic tissue was considered to be an adenoma but upon further reflection it was called aberrant pancreatic tissue. This was confirmed by the microscopical examination. There was no tumor formation; it was just normal aberrant pancreatic tissue with the usual ducts and islands. Such aberrant pancreatic tissue is not extremely rare; it does, however, at times offer a most embarrassing problem when the tissue has to be excised.

THROMBOCYTOPENIC PURPURA

Dr. Seward Erdman remarked that essential thrombocytopenia, or idiopathic purpura hæmorrhagica, is a condition about which little is known as to its cause and its pathogenesis. So-called acute cases are those which undergo spontaneous cure after one sharp attack. If the attacks are repeated the case becomes one of chronic idiopathic purpura hæmorrhagica. It usually occurs in childhood or young adult life. The onset is commonly sudden with mild or profuse epistaxis and the appearance of purpuric spots in the skin, and the development of secondary anæmia. The diagnosis is usually made by examination of the blood.

The outstanding features are reduction of number of blood platelets to less than 75,000, or less than one-third of the normal. Coagulation time may be normal or but slightly prolonged. Bleeding time is greatly prolonged,

even up to thirty or sixty minutes or longer. In his case the bleeding time as recorded was only slightly lengthened.

A tourniquet placed about an extremity for five minutes produces petechiæ in the skin below the constriction. The spleen is usually only very slightly enlarged. The effect of splenectomy is immediate and quite spectacular.

He presented a girl, aged sixteen years, who was admitted to the Second Surgical Division of the New York Hospital, January 14, 1929, suffering with a large perinephritic abscess about the left kidney. Her previous history seemed unimportant save for the following facts. Although sixteen years of age, menstruation had not yet occurred. About six months prior to admission she began to have series of "pimples" on her neck. Two months ago she had one moderate nose-bleed and this was repeated two weeks later, but has not recurred. Three weeks ago she began to have pain in the left kidney region with fever, which has persisted. The hæmoglobin on admission was 75 per cent.

January 15, 1929, by incision, he drained a large left perinephritic abscess, containing 200 cubic centimetres of pus which showed staphyloccocus aureus on culture. Examination of the surface of the kidney at operation revealed a ruptured cortical kidney abscess. She was discharged, February 2, 1929, with a granulating sinus.

Readmitted to the Medical Service of the New York Hospital February 4, 1929. The day before she had developed severe earache in the left ear, with fever. In the night she had a profuse nose-bleed, and some petechiæ appeared on the feet and hands.

During the next three weeks, no further epistaxis occurred, but the left otitis media developed into an acute mastoiditis.

The blood count February 5 showed red blood corpuscles 1,850,000; hæmoglobin 35 per cent.; white blood cells 16,000; polymorphonuclears 65 per cent. Bleeding time two and one-half minutes; coagulation time seven minutes; platelets 320,000. Blood culture negative.

February 26 a transfusion of 300 cubic centimetres was given.

March 1, 1929, she was transferred to Bellevue Hospital Ear and Throat Division and the next day a mastoidectomy was done. The wound culture showed streptococcus hemolyticus.

June 5, 1929, she was readmitted to the Medical Service of the New York Hospital, with the following interval history.

After the mastoid operation at Bellevue Hospital and a satisfactory convalescence, she was sent to the country (Burke Foundation) for recuperation. In April she was sent home from Burke, because of swollen parotid glands, with the diagnosis of mumps, but the enlarged parotids never subsided and remain quite swollen even now, some nine months later.

Her progress continued fair until May 31, six days before this present readmission, when uncontrollable nose-bleeds set in and many "spots" appeared on her body and extremities.

During the succeeding four and a half weeks, until splenectomy was performed July 8, 1929, the epistaxis and the purpura were practically incessant. No benefit was obtained from repeated packing of the nares, nor from the exhibition of calcium lactate and other preparations.

A total of eight transfusions of 500 cubic centimetres each was administered, the last two transfusions being even larger, *viz.*; 800 cubic centimetres and 750 cubic centimetres respectively. The bleeding, however, was nearly

continuous, there being actually only two intermissions; one which lasted for eight days and the other for a period of three days. At times there was vomiting of blood and tarry stools and the purpuric spots were both large and small. The tourniquet test produced petechiæ. Numerous blood counts and blood cultures were made. The blood cultures were negative except on June 12 when one plate showed staphylococcus aureus, and this was thought to be contamination.

The hæmoglobin ranged from 31 per cent. to 53 per cent.; the red cells averaged about 2,200,000; the bleeding time varied from 5 up to 16 minutes; the coagulation time ran from 4½ minutes down to 1½ minutes. The blood-platelets ran as follows: 56,000—118,000 (at which time the bleeding stopped for eight days) then fell to 28,500 and finally to 28,000.

Operation.—July 8, 1929, she was transferred to the surgical wards for splenectomy. Her condition at this time was deemed very critical by both physicians and surgeons and active bleeding was present on this day.

A large transfusion of 800 cubic centimetres was given two hours prior to the operation and another transfusion of 750 cubic centimetres was started during the performance of the splenectomy.

July 8, 1929, a left rectus incision was employed and the spleen found to be but little larger than normal; free from adhesions. Its pedicle was carefully ligated and the organ removed without great difficulty and with practically no loss of blood.

From the moment of removal of the spleen, all bleeding ceased and has not recurred at any time. The convalescence was smooth and the patient was discharged July 26, 1930.

Follow-up.—Later blood examination showed that the blood-platelets had returned to a normal count. The patient has gained markedly in weight and is in excellent physical condition. A moderate enlargement of both parotid glands persists but without symptoms.

Pathological report.—The spleen as received in the laboratory measured 14 by 8 by 4 centimetres. The malpighian bodies are prominent on section, appearing white against a soft red background. There is some increase in connective tissue. The malpighian bodies show large germinal centres and there is some lymphoid hyperplasia of the sinuses.

Whether this case is to be considered a true case of idiopathic purpura hæmorrhagica with incidental and concomitant severe infections, or whether it may be considered as a case of secondary purpura such as is reported with certain hemolytic streptococcus infections also in agranulocytic angina, and in certain blood dyscrasias such as acute leukæmia and aplastic anæmia, may be a matter for argument.

The clinical story of this case is, however, so intimately tied up with a succession of serious pyogenic infections, and the dramatic cure by splenectomy is so suggestive that we are inclined to the belief that this case rather convincingly suggests that pyogenic infections must be very seriously considered as an important factor in the etiology of thrombocytopenic purpura.

Such frank and severe infections as marked this case will of course be lacking in the history of other cases of this disease, but as most cases occur in children and young adults among whom tonsil infections are so common, it is quite conceivable that even the minor infections may play an etiological rôle.

RESECTION OF ILEO-CÆCAL JUNCTION FOR CARCINOID TUMOR OF ILEUM

DR. HERMANN FISCHER presented a woman, fifty-nine years of age, who was admitted on November 23, 1929, to the Lenox Hill Hospital with the following history: Was in good health up to three months ago when she began having attacks of pain in the lower and middle portion of the abdomen. The pain was severe and cramplike in character and usually came on an hour after she ate or drank anything. Shortly after the onset of the pain she would feel nauseated and sometimes vomited bitter greenish colored material and at other times just the food she had previously taken. States that her abdomen would become distended during an attack; as soon as she passed gas the distention would disappear and the pain would be relieved. Had been troubled with constipation for years, but during the past two months it had been more severe and she is unable to have a bowel movement without the aid of an enema or a cathartic. During the past month her attacks have been more frequent and she now has them about every fifteen minutes.

Her past history and family history were irrelevant, except that she had a tumor of the back removed fifteen years ago. She was an emaciated, chronically ill-looking woman.

Her lungs presented no abnormalities. Heart not enlarged. In the apical region one hears a soft blowing systolic murmur which is transmitted for a short distance outward and also upward. Sounds are regular, of fair quality. Moderate arteriosclerosis.

Her abdomen was distended, but fairly soft. One palpated distended gurgling large intestinal coils and there is discomfort on pressure over the whole abdomen which is accentuated in the right lower quadrant. There is tympany over the abdomen. In the right lower quadrant one obtains a sense of resistance to the palpating finger but no definite mass can be made out.

November 25, 1929, Dr. P. K. Sauer made a right midrectus lower abdominal incision. Intestines found obstructed at ileo-cæcal junction. Pelvis found filled with irregular hard masses which feel like carcinomatous tissue. So many adhesions were present that it was impossible to distinguish the point of origin of the carcinoma without extensive dissection. A loop of ileum near ileo-colic junction was therefore brought out through the abdominal wound, and an ileostomy was performed. A Paul's tube was fastened into the gut and the abdomen closed around it by layer sutures. The patient made a good recovery after this operation and was relieved of her obstruction. After several weeks her general condition had so much improved that it was thought safe to try to relieve her of the cause of her obstruction.

December 28, 1929, she was again operated upon by Dr. H. Fischer. Incision through previous scar. Pelvic adhesions present at previous operation were first explored. These were seen to be secondary to small multiple calcified fibroids of the uterus and were not in any way causing the intestinal obstruction. The ileo-cæcal region was now explored and a mass felt in the cæcum, practically located at the ileo-cæcal junction, completely occluding the terminal ileum at that point. Liver smooth, no evidence of metastasis. A resection of the lower ileum, the cæcum and part of the ascending colon was done. An end-to-end anastomosis was used to reconstruct the continuity of the bowel. The patient made a good recovery and has been feeling well since. The pathological examination of the specimen shows the following: The wall of the terminal ileum is thickened and at its junction to the cæcum is constricted by a mass which replaces the wall. On opening the lumen of the gut, this mass is seen to be annular in type and to completely occlude the lumen of the cæcum. The tumor mass is 3.4 centimetres wide, is hard,

fibrous and firmly attached to the tissues of the wall. On the mucosa, the dividing line between tumor and relatively normal mucosa is sharp, but in the deeper layers the tumor is continuous with the wall of the gut. The ileocæcal valve is pendulous and hangs in the lumen of the cæcum.

Microscopical examination of sections obtained from one part of the tumor shows an epithelial growth composed of small, deeply stained polyhedral cells with vesicular nuclei and scanty protoplasm. These cells are usually disposed in solid masses of various sizes, some of which are very irregular. The epithelium shows a tendency to retract from the stroma. Some of the cell masses enclose small lumen-like spaces, and in one part of the tumor are a few small, well defined acini lined with cuboidal epithelium. The stroma varies in amount, though it is mostly rather scanty and dense and acellular. The tumor deeply infiltrates the gut wall and in many places the epithelium rests directly upon the smooth muscle.

The tumor is of the type of the so-called carcinoids, which not infrequently are found in the appendix. There are metastases in several of the lymph glands.

Dr. Seward Erdman considered the occurrence of carcinoid tumors of the appendix to be not uncommon as he thought that a small percentage of all cases of chronic appendicitis would show a small carcinoid within the appendix. Ten years ago he operated on a young woman who had presented marked symptoms of acute intestinal obstruction in the lower ileum. Resection at the site of the obstruction disclosed a carcinoid tumor of the ileum which almost completely obstructed it. There were no enlarged nodes. The patient had not been in good health even after the operation; a year ago she was in the Battle Creek Sanitarium and was now in the Massachusetts General Hospital for treatment for marked anæmia and continuous loss of weight. The cause for this condition had not been diagnosed. Her chief complaint is weakness. Two years ago Doctor Lahey, of Boston, performed a hysterectomy for fibroids. Having been informed of her previous operation, on opening the abdomen he examined the anastomosis site carefully and could see no sign of recurrence. It is probable that the cause of her present ill health will not now be diagnosed before autopsy which might possibly reveal some manifestation of carcinoid recurrence.

Dr. Fischer in closing the discussion said that these carcinoids do not often metastasize, but in this case there were very distinct metastases in the mesenteric glands of the cæcum. The pathology was much the same as that found in carcinoids of the vermiform appendix.

RESECTION OF STOMACH FOR ULCER

Dr. Hermann Fischer presented a man, aged sixty-seven years, who was admitted to the Lenox Hill Hospital December 19, 1929, with the history that he had been in fairly good health until two months ago when he began having a heavy feeling of distention in the epigastric region. This came on at irregular periods after meals and was accompanied by gaseous and sour eructations. No pain, nausea and vomiting. About the same time he began to lose his appetite. His bowels have been regular and he has never noticed blood in his stool. No loss in weight. A week ago he began having hiccoughs shortly after the taking of food; at first they would last from two to three hours, but for the past two days he had them constantly. Past and

family history negative. He had lost a leg through an accident. He was an elderly, fairly healthy looking man. Teeth poor, tongue coated. Lungs: Diminished resonance at both apices, but no râles. Dulness at both bases with occasional moist small râles. Heart: sounds regular, normal in rate and very soft, poor in quality. Pulse is regular, fair tension, moderate arteriosclerosis. Abdomen obese and flaccid. Double inguinal hernia, easily reducible. The liver is felt one and one-half finger's breadth below costal margin, smooth and not tender. The spleen is not felt. No abnormal masses, tenderness or rigidity. Left leg is amputated in the middle third of femur. Urine contains albumin, occasional hyaline cast. Blood count: 4,850,000 red cells; hæmoglobin 88 per cent.; leucocytes 11,800. Stomach contents: P. C. free acid 14; tot. acid. 31; blood + +. X-ray examination: There is noted a moderate-sized gastric ulcer crater in the midportion of the lesser curvature. There is also a constricting lesion of the pylorus producing a canal about one inch in length. From the röntgen appearance there would be suspicions of malignancy involving the pyloric region accompanying the gastric ulcer.

Operation January 6, 1930.—Mid-line incision from ensiform cartilage to umbilicus. On opening the peritoneal cavity an indurated, hard, irregular mass was felt and seen about midway between pylorus and cardia of the stomach at the lesser curvature. As a strong suspicion existed for the possibility of a carcinoma a subtotal gastrectomy after Billroth I was done. There was no evidence of glandular or hepatic metastasis. The pathological examination proved the lesion to be an ulcer. The patient made an uneventful recovery and feels well today.

RESECTION OF CARCINOMA OF THE TRANSVERSE COLON

Dr. A. Hyman presented a man, thirty-five years of age, who was admitted to Mount Sinai Hospital October 25, 1929, with the history that one year ago he had dull pain in left lumbar region radiating anteriorly, lasting about fifteen minutes. No urinary symptoms. Three months ago there was a second similar attack, followed by hæmaturia. Cystoscopy and X-ray were negative. Since then he has had rather constant low-grade pain in the left lumbar region.

Two months after the onset of this condition cystoscopy and X-ray showed a small stone in the left kidney. Following this he was well except for occasional dull pain in the left lumbar region until five months later (two and one-half months ago), when he had a very severe dull pain in the left lumbar region lasting six hours. With this attack he had frequency and hæmaturia. Two weeks afterwards he passed two small calculi. X-ray and cystoscopy following this were negative.

His present illness began four months ago with general abdominal cramps occurring daily, unassociated with meals. There was no nausea or vomiting. Bowels fairly regular; no melæna.

Two months ago he felt a small mass in the lower left quadrant of the abdomen, sausage-shaped, freely movable and two to three inches in length. His appetite had been good, and he had lost only a few pounds in weight. When admitted he was very pale, although fairly well nourished. Heart and lungs were negative. A freely movable, round mass about the size of a golf ball was palpated in the lower left quadrant of the abdomen. This mass could be felt on some occasions, and was absent on others. Rectal examination was negative, as were cystoscopy and X-ray. The urinalysis was normal. The hæmoglobin was 70 per cent, polynuclears 80 per cent, and 10,000 white blood cells were found; the blood urea showed 12 milligrams per 100 cubic centimetres. The Wassermann was negative. A barium enema showed the colon to fill readily to about the mid-transverse colon, where an area of nar-

rowing was encountered. There was no obstruction or delay, however, at this point.

October 25.—*Operation*, under gas and oxygen—Resection of transverse colon with side-to-side Murphy button anastomosis. Cæcostomy for carcinoma of the transverse colon. Six-inch left transrectus incision. Findings. —Tumor the size of a tennis ball covered over with omentum and exudate in midportion of transverse colon. The growth was not adherent to the surrounding structures. Resection of growth using Payer clamps. It was found that after resection a suture anastomosis would be under tension unless the gut was mobilized freely on either side, and a large Murphy button side-to-side anastomosis was accordingly done. Considerable glandular involvement was found in the mesentery. A Witzel cæcostomy was then done through a McBurney incision.

The post-operative course was remarkably easy. There was only slight distention and vomiting on several occasions. Flatus was expelled on the fifth day. On the eighth day there were fluid bowel movements. The cæcostomy tube was removed on the ninth day, as drainage had practically ceased. There was never any fæcal discharge from the site of the anastomosis. There was slight infection of the main incision, which cleared up rapidly. The patient was discharged from the hospital with both incisions almost healed.

November 17, twenty-three days following operation, he was having formed bowel movements daily. The button was not passed until the 19th of January. He was not able to pass the button himself, but it was readily removed by grasping it with the forceps.

The pathological examination of the specimen was reported as "Carcinoma with perforation into the omentum and abscess formation." The lymph nodes were not involved.

SUPPURATIVE RETROPERITONEAL PELVIC LYMPHADENITIS

Dr. A. Hyman read a paper with the above title for which see page 718.

Dr. Carl G. Burdick referred to a case observed by him in Bellevue Hospital. The patient was a woman twenty-seven years of age, who had been admitted to the hospital in December complaining of a pain in her left groin, which radiated down her thigh. Her temperature rate varied from 101° to 103°. There were some glands palpable in the left femoral region. Pelvic examination revealed a mass in the true pelvis. X-ray of the sacro-iliac synchondrosis was negative. A diagnosis of retroperitoneal lymphadenitis was made and she was treated with hot douches for ten days. The mass gradually increased in size until it extended up into the iliac fossa. The abscess was incised through an incision parallel to Poupart's ligament and two or three ounces of pus evacuated. Her condition improved but at the end of seven or eight days her discharge became bloody. It was, however, learned that she was menstruating. After five days her discharge again became purulent. She made a satisfactory recovery and was ready to go home when she started to menstruate again and had a bloody discharge from her wound. Pelvic examination was negative. Lipiodol injection of the uterus and tubes and a second injection of the sinus failed to reveal any communication between them. Menstruation ceased and the discharge became purulent again. She was discharged from the hospital a few days later.

BRIEF COMMUNICATIONS

TUBERCULOMA OF THE DESCENDING COLON

CHRONIC HYPERPLASTIC TUBERCULOSIS

TUBERCULOMA is a term now being generally used for the condition commonly known as chronic hyperplastic tuberculosis. It being exceedingly rare in the left half of the colon, the report of the following case is considered worth while.

A man, white, age twenty-two years, single, was first seen by the writer June 1, 1926. At this time he stated that he had been in his usual good health up to seven or eight months previously when he began to lose weight and strength and to suffer from "indigestion." His appetite gradually became very poor. He became more and more constipated and had frequent attacks of generalized colicky abdominal pain, most marked as a rule in the left half of the abdomen. His condition has grown progressively worse and he has lost about thirty pounds in weight and has lost markedly in strength. For the past two months he has had attacks of abdominal pain daily. The pain is sharp, of two or three minutes' duration, and always precedes defecation, and as a rule is relieved immediately thereafter. For the past two or three months has complained of considerable bloating and belching. At no time did he notice any blood in his stools.

Previous to his present illness he had been very rugged and well and was very prominent and active in athletic circles. He has had the usual diseases of childhood. He has never had any chronic cough, night sweats, palpitation, etc. His mother, father, and two sisters and two brothers are living and well. There is no family history of carcinoma or tuberculosis. The man himself is undernourished and appears chronically ill, pallor being quite marked. Physical examination negative for head and chest, except a chronic infection of the tonsils. Pulse, 90; temperature, 99.5°; respiration, 18.

The abdomen is scaphoid, of symmetrical contour throughout; no signs of fluid present; moderate tenderness and rigidity present in the left lower quadrant; about two inches internal to the left anterior superior iliac spine, palpation reveals a round, hard, sausage-shaped tumor about two inches in length, which is tender to touch and seems quite fixed in position, occupying the region of the left colon. The spleen and liver are not palpable.

X-ray examination of the gastro-intestinal tract: Negative, with the exception that a large barium clump is present in the ascending and transverse colon for a considerably longer time than normal.

Blood examination.—June 6, 1926: hemoglobin, 75 per cent.; red blood cells, 4,000,000; white blood cells, 22,900; polymorphonuclears, 79 per cent.; small mononuclears, 15 per cent.; large mononuclears, 6 per cent.; blood Wassermann: negative.

Urinalysis: specific gravity, 1.008; amber color; reaction acid; albumin: negative; sugar: negative; microscopic examination of the urine shows a small amount of débris present.

June 9, 1926, the patient entered the hospital for further observation. *X-ray report* after a barium enema given June 19: "Narrowing of colon for six inches above the sigmoid, the barium shadow being only about a finger's breadth in width in this portion. X-ray diagnosis: Neoplasm of colon."

From the time of patient's admission to the hospital June 9, 1926, up to June 19, 1926, he had a daily evening rise of temperature to 99° and 99.5°.

Operation June 19, 1926. Gas-ether anæsthesia.—Abdomen opened through a left rectus incision extending from the level of the umbilicus to just above the pubic bone. A small amount of clear fluid was present in the lower part of the abdominal cavity. The whole length of the descending colon from the splenic flexure to the sigmoid was involved in what was apparently a chronic hyperplastic tuberculosis (Fig. 1). The peritoneum was markedly congested and covered with tuberculous granulation material. The walls of the colon throughout its entire length were markedly thickened and very hard, which condition caused a marked encroachment upon the lumen of the bowel, incomplete intestinal obstruction resulting. There was moderate thickening of the splenic flexure and the first inch or so of the sigmoid. The descending meso-colon was markedly contracted and thickened which resulted in the colon being firmly fixed in position, immovable and retracted posteriorly to a marked extent. Numerous enlarged glands of various sizes were present in the meso-colon and along the blood-vessels running to the colon. The sigmoid colon proper was quite normal as was the entire remainder of the gastro-intestinal tract, no other evidences of tuberculosis being present.

FIG. 1.—Tuberculoma of the descending colon.

The gall-bladder was normal in size; its contents were easily expressed. Both kidneys were apparently normal in size, shape and position. Two glandular masses at the base of the wall of the colon were excised for biopsy. Resection of the involved portion of the colon not being considered feasible, an isoperistaltic anastomosis was performed between a loop of the ileum about eighteen inches from the cæcum and the sigmoid colon, after which a cigarette drain was inserted in the lower part of the pelvis and the abdomen closed in layers.

The patient remained in the hospital for ten days following the operation, the abdominal wound healing by primary union. The post-operative course was uneventful with the exception that beginning on the fourth day, the patient began to have frequent defecations throughout the day and night, these continuing during the remainder of his stay in the hospital, some relief being obtained from the administration of opiates and astringents.

The pathological report of the tissue excised at operation is as follows: "Specimen: Lymph glands. The specimen consists of two small pieces of tissue, glandular in type. Two sections are taken to be prepared for microscopic study.

"*Microscopic examination.*—The tissue is lymph gland showing early tuberculous formation with giant cells in typical epithelial cell arrangement around the periphery of the lesion. The tubercles are found in the two sections examined.

"*Diagnosis.*—Early stage of tuberculous infection of lymph glands."

For the first six or eight weeks following the patient's discharge from the hospital, his condition seemed satisfactory, in many respects, in that he appeared and acted better than for some time previously, although the frequent defecations or diarrhœa were never entirely controlled. After the first few weeks of apparent improvement, however, he started to fail. The diarrhœa persisted. His appetite became very poor and he gradually lost in weight and strength.

After being in attendance about five months, post-operatively, the writer was dismissed from the case.

At no time during the pre-operative or post-operative course of the case was there any manifestation of tuberculosis elsewhere in the body.

Following my discharge I ascertained that the patient continued to fail progressively and death occurred about ten months after I operated upon him.

Comment.—Tuberculosis of the intestine, according to one classification occurs in four types:

1. Ulcerating or tuberculous enteritis. It may be primary in children but in adults is secondary to pulmonary tuberculosis. It is stated by some authorities that this type occurs in 50 per cent. of the patients who died of pulmonary tuberculosis.

2. Cicatricial or stenosing type resulting from healing or annular ulceration of the bowel.

3. The entero-peritoneal type, characterized by an ulcerating, caseating lesion of the ileocæcal segment with a marked tendency to softening and suppuration. External fistula is common in this type.

4. Chronic hyperplastic tuberculosis, characterized by variable but considerable hyperplastic annual thickening of the wall of the bowel. This type was first described by Hartmann and Pilliet in 1899. It usually affects the ileocæcal region, producing an ileocæcal tumor. Occasionally the rectum is involved; less commonly the ileum, together with the cæcum. Involvement of the ileum alone is almost never seen, only eight cases having been reported in the literature. It is a disease of long duration and the lesion is characterized by extensive formation of fibrous and tuberculous granulation material. The submucosa in these cases is greatly thickened by fibroblastic hyperplasia and by lymphoid cells. In the muscle layer there is marked hypertrophy of the muscle bundles which are separated and in places destroyed by aggregations of lymphoid and epithelioid cells.

This variety of tuberculosis is considered a primary lesion in a high percentage of cases both because of the inability to demonstrate tuberculous infection elsewhere, even at autopsy, and because of the cure by extirpation of the local lesion. Occasionally, however, tuberculosis elsewhere will be demonstrable as a coëxisting lesion with hyperplastic bowel tuberculosis.

The exact reason for the appearance of tuberculosis, particularly in the ileocæcal coil, is explained variously by different observers. Stagnation and fermentation unquestionably take place in the cæcum and the organisms undoubtedly lose some of their virulence upon reaching this portion of the intestinal canal, infection resulting from a combination of these factors.

Calmette believes that the infection takes place through the circulation, the bacilli passing through the mucous membranes of the bowel without injury to it and lodging in the regional lymphatics, the pathological reaction producing scar tissue and not ulceration, with a resultant tumor formation. This latter explanation seems most satisfactory to the majority of writers.

The disease occurs by far the most often in comparatively young individuals and particularly in male subjects.

In a treatise on "Tumors of the Rectum and Colon," published as late as 1925, no mention is made of this condition. Dr. W. J. Mayo states that he believes these cases were more common in the early days when many opportunities were afforded for infection from bovine tuberculosis and that it was not possible to remove the menace from milk until it was found that hogs were infected with tuberculosis from the milk—and then of course something had to be done about it.

The treatment of these cases is surgical. If possible, resection of the involved segment should be done; otherwise an entero-anastomosis between the proximal and distal parts of bowel wall beyond the diseased area.

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From the Providence Hospital.

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CONGENITAL ABSENCE OF THE GALL-BLADDER IN MAN*

CONGENITAL absence of the gall-bladder in man is a rare occurrence. Bower [1] (1928) collected sixty cases from the literature (one case from a double liver; thirteen cases of absence of the gall-bladder and all the ducts; fifteen cases of absence of the gall-bladder, common and cystic ducts, including his own case; thirty-one cases of absence of the gall-bladder and cystic duct). Knox [2] reported two instances in 2000 autopsies; Mentzer [3] and Nagel one in 1600 autopsies. Schaeffer [4] has seen this condition once in approximately 3000 dissections, the case here reported.

If no gall-bladder is found at operation or autopsy one of three conditions is possible: First, the gall-bladder may have been removed at a previous operation; however, the history and the physical examination of the patient should preclude this possibility.

Second, the gall-bladder may be buried in the liver, the so-called intrahepatic gall-bladder. In such instances cholecystography should be of value. Lintz [5] reported a case in which tetrabromophthalein was administered to a patient and failed to outline a gall-bladder, which at operation was proven to

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be congenitally absent. Lemon[6] found and removed two stones from an intrahepatic gall-bladder.

Third, the gall-bladder may be congenitally absent.

This report records an instance of congenital absence of the gall-bladder and the cystic duct, found in a cadaver during routine dissection.

Clinical History.—J. R., a white male, fifty-seven years old, was admitted to .... Hospital, May 25, 1927, with the diagnosis of chronic active fibroid pulmonary tuberculosis, chronic fibrous pleurisy and chronic myocarditis. The patient stated that "his stomach had never been strong"; that he was subject to constipation and attacks of nausea and vomiting without jaundice; and that no operations had ever been performed.

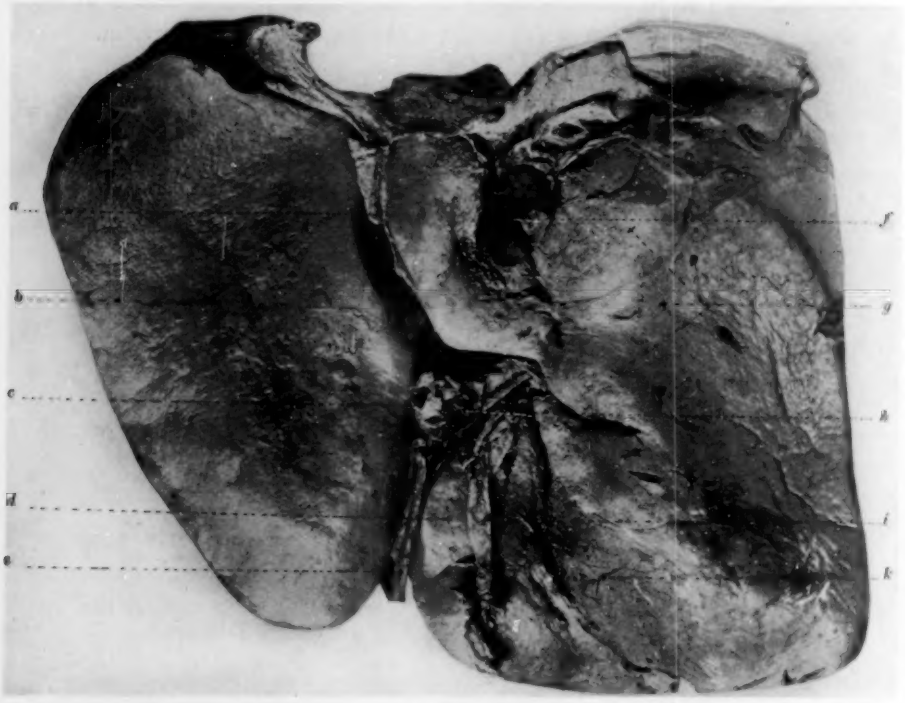

FIG. 1.—Photograph of the Liver specimen: *a*. Caudate lobe. *b*. Left lobe. *c*. Hepatic artery. *d*. Quadrate lobe. *e*. Round ligament. *f*. Inferior vena cava. *g*. Right lobe. *h*. Portal vein. *i*. Common bile duct. *k*. Usual site of the gall-bladder.

Physical examination revealed a well-developed adult, 5 feet 6 inches in height, weighing 150 pounds. The chest showed the signs of active tuberculosis. The abdominal examination recorded some rigidity of the muscles and slight tenderness over the gall-bladder region. No scars or palpable masses were found. Death occurred May 2, 1928.

Description of the Liver.—Careful post-mortem examination of the abdominal wall and related structures proved conclusively that no operation had been performed.

Upon opening the peritoneal cavity, the liver appeared normal as to size, shape and anatomical relations. The right lobe measured 17 centimetres, the left lobe 11 centimetres, the caudate lobe 4 by 6 centimetres, and the quadrate lobe 3 by 5 centimetres. The gall-bladder and the cystic duct were absent, the usual site of the gall-bladder fossa being a convexity (Fig. 1). The capsule and peritoneum over this region were intact and microscopically wholly devoid of any gall-bladder tissue. The common bile duct which drained the biliary system of the liver (in a sense that was no common duct in view

of the absence of the cystic duct) was 9 centimetres long and 8 millimetres wide, with the normal relations, namely, to the right of the hepatic artery and ventral to both the hepatic artery and the portal vein. The channel representing the common duct received the pancreatic duct 1 centimetre from the duodenal papilla (ampulla of Vater).

Technic Employed in Excluding an Intra-Hepatic Gall-Bladder.—In order to exclude the possibility of an intrahepatic gall-bladder the liver was injected through the common duct with lipiodol and X-rayed.

The common bile duct was exposed from the portal fissure to the duodenal papilla, by dissecting it free from the lesser omentum, the pancreas and the duodenal wall. Having thus identified the duct, a cannula was securely tied in a slit in the lumen 1 centimetre from the liver, so that the pressure necessary to force the oil into the finer bile ducts of the formalin-hardened specimen would not rupture the common duct and spread the opaque material over the liver surface. An injection-syringe with 2 cubic centimetres of lipiodol (Lafay) was then attached to the cannula and the preparation placed

FIG. 2.—X-ray plate of the injected liver. The intra-hepatic bile ducts as outlined by the lipiodol have been traced over with India ink. Note the absence of any accumulation of the opaque mass, proving that the gall-bladder is not buried in the liver substance.

on the fluoroscopic table. Using considerable hand pressure, 1½ cubic centimetres of lipiodol was injected into the common bile duct, controlling the spread of the oil into the finer bile ducts under the fluoroscopic screen. X-ray plates of the injected liver with the cannula in place were taken by Dr. J. T. Farell, Jr.

Examination of the X-ray plate taken at the conclusion of the injection (Fig. 2) shows the right and left intrahepatic bile ducts and their ramifications clearly outlined. There is no collection or massing of the oil at any point within the liver as would occur if the gall-bladder occupied an intrahepatic position.

This case proves therefore to be one of congenital absence of the gall-bladder and cystic duct in man, as determined by the history of the patient, the gross examination of the liver and the intrahepatic injection of the bile ducts with lipiodol, and the X-ray plates.

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PLASTIC REPAIR OF PARTIAL LOSSES OF THE NASAL TIP

PLASTIC repair of partial loss of the nasal tip is beset with many difficulties. In the first place, the loss is not extensive enough to warrant the

FIG. 1.—Partial loss of nasal tip.

FIG. 2.—Final result secured by the graft.

swinging of a forehead flap, which always leaves a permanent scar, and, in most instances, if used would be too thick to produce the finest result. Free grafting is impracticable because of the inability to get the satisfactory pressure necessary for a full-thickness graft; and the Thiersch graft, even though it might take, would not have body enough to produce the desired cosmetic result. Hence, we are called upon to repair these defects in another way, by using pedicle flaps, two from the arm and one from the neck.

The following cases are presented in an endeavor to show a simple and certain method of dealing with small losses of the nasal tip, without mutilating the forehead.

FIG. 3.—Tube pedicle graft from arm in process of formation.

FIG. 4.—Tube pedicle graft approximated to face and sutured to refreshed nasal tip.

FIG. 5.—Pedicle tube graft taken from neck.

FIG. 6.—Final result obtained in the case shown in Fig. 5.

CASE I.—Fig. 1 is a case of partial loss of the nasal tip due to a bite. Repair was attempted several times by the use of free grafts, and in each instance failure resulted because of the inability to maintain sufficient, firm, and even pressure. A tube pedicle graft from the inner aspect of the left arm was decided upon because of its easy accessibility, similarity of color and texture, and freedom from hair. A tube was made which can be seen in Fig. 2 and after a ten-day interval it was transplanted to the nose. The arm end was severed at the end of four days and utilized to make up the columellar loss. Fig. 3 shows method of fixation while the tube is attached to the nose. The time generally allowed for a transplant to attach itself firmly is about ten days but in this case due to the highly nervous state of the patient it was released sooner without harmful result. Fig. 2 shows the final result.

CASE II presented a partial loss of the nasal tip due to the previous removal of an angioma. The procedure in this case was an exact duplication of that reported in Case I with the exception that no free grafts were attempted and ten days were allowed for the transplant to fix itself firmly before severing the arm pedicle. The final result was equal to that obtained in the preceding case.

CASE III shows a loss of the right ala following excision of a basal carcinoma by diathermy, one year being allowed before repair was attempted to make certain there was no recurrence. In this case an arm graft was deemed inadvisable because the patient had been an outdoor worker for years and the skin of the face was so hardened and tanned that it did not match the arm skin. As can be seen in the picture (Fig. 5), a tube pedicle graft was taken from the neck. Except for the source of the skin the technic was the same as in Case I. Fig. 6 shows final result.

From the Plastic Clinic of the New York Postgraduate School and Hospital.
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BOOK REVIEWS

I. Surgical Diagnosis. By American Authors. Edited by Evarts A. Graham, M.D. 3 octavo volumes; 2,750 pages; separate index volume. Philadelphia, W. B. Saunders Co., 1930.

II. Demonstrations of Physical Signs in Clinical Surgery. By Hamilton Bailey, F.R.C.S., Eng. 2nd edition, octavo; cloth; pages 268. New York, Wm. Wood & Co., 1930.

I. The changing conditions in the field of surgery that the present generation has witnessed are well illustrated by Graham's three-volume book in which forty-two American surgeons have coöperated. As one looks over the list of contributors to this work, one is impressed with the fact that here is a list composed from the new generation which has come upon the American surgical stage since the appearance in 1892 of the coöperative American Text-book of Surgery edited by Keen and White. The preface to the original edition of that American Text-book bears the date of August 1, 1892, nearly thirty-eight years ago—more than a generation. The senior editor of the book, the venerable Dr. William W. Keen, is still living and actively interested in the progress of surgery; all the other authors, with the exception of the writer alone, have passed away.

Diagnosis was not overlooked by the writers in that volume. Since that time diagnosis has engaged repeatedly the special attention of various writers. The earlier books of Kiliani, A. B. Johnson and Eisendrath have not been forgotten. DeQuervain and Donhauser are still quite up to date. It is now ten years since, under the leadership of the lamented Albert J. Ochsner, a large four-volume treatise on Surgical Diagnosis and Treatment was put forth by American authors. The contributors to that treatise included seventy-five of the active surgical workers of that day in America. The changes which a few years may bring about are well illustrated in the fact that not one of these names of men who were our authorities in surgical diagnosis ten years ago appears in the list of the forty-two men who are assembled as the authorites in the present book.

The recent volumes devoted to Surgical Diagnosis from the pens of thirty-one British surgeons, edited by Walton, of the London Hospital, are still fresh from the press. Such an appreciation of the importance of the subject as these rapidly successive and bulky volumes indicate is unmistakable. Diagnosis is at the very root of successful practice, in surgery even more than in internal medicine, which latter, in larger proportion than in surgery, may be relied on for spontaneous cure however mistaken may have been the diagnosis and misdirected the treatment.

II. In sharp contrast with the more elaborate books above mentioned, is this book of Bailey which limits itself to the description of those physical signs which may be of use in the diagnosis of surgical conditions. To accomplish this, the author has assembled an extensive group of illustrations, 306 in number to be accurate, to each of which is attached a certain amount of explanatory text, brief and aphorismic in character. It is quite evident that the idea of the book originally was that of a hand-book for the use of the medical student. For the best use of the book, it is, however, undeniable that considerable more of clinical training and experience must have been enjoyed by any one who expects to get the full benefit of it than could be expected from even a fourth-year medical student. There is no one, however, who has to do with surgical conditions who would not derive benefit from its pages.

The two works, the more extensive system edited by Graham and the axiomatic compend with its mass of illustrations prepared by Bailey, supplement one another admirably.

The Graham system presents a series of elaborate monographs admirably stating the teaching of the present day. It is a valuable book of reference in which the practical surgeon will find a mine of well-ordered information in whatever department of surgical diagnosis he may desire help. The tone of scholarly accuracy and of completeness of scope in the treatment of special conditions calls for high commendation.

LEWIS S. PILCHER

OTOLOGIC SURGERY. By SAMUEL J. KOPETZKY. 8vo. Cloth. Publishers, Paul B. Hoeber, Inc., New York, 1929.

The second edition of Doctor Kopetzky's *Otologic Surgery* offers the author a great opportunity not only to bring the subject of otologic surgery up-to-date but also serves to elucidate some of the subject matter which, in the first edition of four years ago, was of necessity not completely conclusive. The classification of middle-ear diseases based on pathogenesis is a distinct advance over the previous classification. The first edition classified the middle-ear diseases in accordance with their clinical aspect. Very obviously this not only limits the classification to two general classes but fails to give an adequate picture of the various types of pathology. The new edition presents a very complete classification and illustrates very clearly the decided advantages of basing all diseases on their pathology. This basis, once accepted, presents a common ground for study as well as an accurate indication for treatment.

The chapter on "The Surgery of the Labyrinth" is so superior to the previous chapter on this subject as to alone justify the author in the publication of the new edition. "Pathogenesis of Suppurative Labyrinthitis" is new and well illustrated. "Classification of Purulent Labyrinthitis" is also

new and very welcome. The physiological note and "General Remarks Concerning the Labyrinth Tests" are an addition that should be particularly well received. This is one of the most comprehensive and altogether noteworthy contributions on this phase of labyrinth diseases which has been written. The few pages devoted to this subject will merit careful study.

Otitic sepsis is always a serious problem and Doctor Kopetzky in the chapter devoted to this subject has brought to his discussion of the diagnosis, the pathology and the treatment a large experience and his deductions are worth serious attention. In this particular phase of otology it is well worth noting the transition from an accepted pessimism of a few years ago to the attitude of optimism resulting from the putting into practice of certain measures which have now become well authenticated in the treatment of otitic sepsis.

Chapter IX deals with "The Surgery of the Meninges." The classification on a pathologic basis is a distinct advance and lends itself to a more accurate study of the surgical indications. "The Summary of the Characteristics of the Spinal Fluid in the Various Types of Meningitis" is a most acceptable new contribution. Several illustrations have been added.

The chapter on "The Surgery of Otitic Brain Abscess" contains several features that are most acceptable. The illustrations are more numerous and very illuminating. This chapter has been brought up-to-date and offers a most accurate basis for the diagnosis and treatment of one of the most difficult problems with which the otologic surgeon is confronted. Here again the new illustrations are very helpful.

Chapter XI is new and discusses "Laboratory Aids to Otological Diagnosis." This chapter discusses at length the various laboratory aids to diagnosis. The proper deductions to make are pointed out at length and emphasis is placed on the necessity for every otologist to be able to interpret properly the findings in every case.

The last one hundred pages are devoted to cases illustrating points in the text.

CLAUDE G. CRANE

A TEXTBOOK ON ORTHOPEDIC SURGERY. By WILLIS C. CAMPBELL, M.D., 8vo., cloth; pp. 705. Philadelphia, W. B. Saunders Company.

One of the most striking evidences of the changing aspect of orthopædic surgery is Campbell's new textbook. Time was when mechanical methods dominated in treatment; it is evident after perusing this book that now the methods of operative surgery are definitely in the ascendency.

The publisher's announcement of a "refreshing" book is thoroughly substantiated. The subject is treated in a straightforward manner. Controversial matter is largely eliminated, and theoretical discussion is reduced to a minimum. There remains, however, the conviction that the author's experience is broad and his interpretations sound. The book plunges at once into

the matter of what may be gained from the systematic examination of joint function. This portion of the book is particularly valuable, since the need for such instruction is great. There follows upon this a discussion of affections of joints, which includes practically a quarter of the volume. In this portion is included the general pathology and symptomatology of the chronic arthritides besides a similar elucidation of joint tuberculosis as a logical consequence of that discussion. This serves to place the latter in its proper place from two standpoints: (1) as a question of joint pathology and treatment, and (2) as a question of the general therapy of tuberculosis.

The sections of the book devoted to the author's own great contributions to joint surgery are of special interest to the specialist. The indications for operation are pointed out, and the technic of the operations well illustrated by original drawings. There are three chapters on fractures and dislocations, which matter is necessarily handled in a concentrated manner, but it is intensely practical. The author in general favors manipulative reduction of fractures, with fixation in plaster-of-Paris. Traction methods are not illustrated. The nomenclature of fractures of the hip is a little confusing, in that what is ordinarily called a subcapital fracture is illustrated as a central fracture of the neck of the femur. On the other hand, central fracture of the acetabulum is discussed as a central dislocation of the hip.

The rest of the book deals with the ordinary material of orthopædic surgery, and includes a section on bone tumors. The surgery of poliomyelitis is illustrated with a number of the author's own operations.

The book is to be highly recommended as a concise exposition of a difficult subject.

ARTHUR KRIDA

MEMOIR

DR. JOHN DIKEMAN RUSHMORE

1845–1929

Dr. John Dikeman Rushmore was born in Brooklyn, N. Y., September 5, 1845. The Rushmores came from England in 1621. From the Dikemans also he inherited qualities characteristic of the sturdy old English and Dutch stock. He graduated from Williams College, Mass., in 1867. He then matriculated in the College of Physicians and Surgeons in New York, from which he received his degree of Doctor of Medicine in 1870. He thereupon accepted a service in the Children's Hospital on Randall's Island and later became associated, as attending surgeon, at the Brooklyn Hospital where for a time he was responsible for all the orthopædic work.

John D. Rushmore, M.D.

He was a musician of ability, playing both organ and piano equally well. He was a notable Shakespearean scholar. In his personal contact with his patients and his colleagues he was always the gentleman, courteous and kindly.

Doctor Rushmore was associated with the Long Island College Hospital for fifty-four years. He taught in the College for thirty-five years and during that time was Dean of the Faculty and occupied the Chair of Operative and Clinical Surgery. The list of positions held at this institution is long and varied and speaks eloquently for the great versatility of the man. In 1873 he became lecturer in elementary surgery, holding this position until 1875 when he was made lecturer on Materia Medica and Therapeutics. He held this post from 1875 until 1877. Thereupon he was promoted to the grade of Professor of the Principles and Practice of Obstetrics and of Clini-

cal Obstetrics. In 1880 he received his major appointment in the College, that of Professor of Surgery, a position he held until 1915. In that year, at the age of seventy, in full possession of his faculties and still keenly interested in all that pertained to the Long Island College Hospital, Doctor Rushmore tendered to the faculty his resignation. He had acted furthermore in the capacity of Dean of the College from 1903 to 1915.

For fifty continuous years he gave his services to the sick poor of St. Peter's Hospital. He served as Chief Surgeon of this hospital for thirty-five years, and during that time performed practically all the major operations. It was at this hospital that Doctor Rushmore is credited with having performed the first appendectomy and the first gall-stone operation in Brooklyn. He was active in the discharge of his duties at St. Peter's Hospital until a short time prior to his death. General Surgery, even as he became master of it, did not represent his entire surgical activity. He conducted an active service in the Brooklyn Eye and Ear Hospital from 1872 until 1914 and had an unusual interest in diseases of the eye and ear and performed numerous operations on both. He once stated that he was the first man to look into his own eye which he was able to do by means of some kind of ophthalmoscope which he had rigged up for himself. Doctor Rushmore was also the first in Brooklyn to attempt the removal of a foreign body from the lung by means of bronchoscopy. In 1914 he became Consulting Ophthalmic Surgeon at the Brooklyn Eye and Ear Hospital which position he held until his death. He acted as consultant in surgery in various of the Brooklyn Hospitals, among which were the Bushwick, St. Anthony's, Kings County, and Swedish Hospitals. The interests of this man were not encompassed even in the activities already mentioned. He found time even to practise a certain amount of obstetrics and pharmacy.

Doctor Rushmore wrote but little. "Ether Anæsthesia" (1892) and "Some Surgical Thoughts on Appendicitis from a Clinical Standpoint" (1894) are among his best known contributions. He held membership in numerous medical societies and clubs, among which were the American Surgical Association, American College of Surgeons, New York Surgical Society, New York Ophthalmological Society and the Practitioners' Club of Brooklyn. In January, 1928, he suffered an attack of influenza after which he never regained his old-time vigor. Finally, March 23, 1929, in his eighty-fourth year, after a few days' acute illness he died.

EMIL GOETSCH

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